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Education of Machinists, Foremen and Engineers.

In this issue we complete the publication of a very full abstract of Prof. Higgins' paper, entitled "Education of Machinists, Foremen and Mechanical Engineers." We print this paper not merely to fill space, but because we believe that every one of our readers should be familiar with Prof. Higgins' statement of his experience and with what he proposes, as a remedy for the present state of affairs. There are some who will probably resent his grouping of the education of machinists, foremen and mechanical engineers together; but in this point, especially, we think Prof. Higgins is just right. We believe the difference in the education of the different classes of men mentioned should be only in degree. We believe that every mechanical engineer is the better engineer for having had shop practice; and by this we mean real shop practice, not that sort of shop tinkering which Prof. Thurston evidently had in mind when he referred to shop work as a "gymnastic exercise of great value." We believe, as we have before stated, that our present great success as a manufacturing nation is very largely due to the fact that our "engineering" work has been largely done by men who at some period of their lives worked in machine shops, not for a "gymnastic exercise," but for bread and butter, and as a means of rising higher as circumstances gave opportunity.

We believe that just in proportion as we get away from this, so that our so-called engineering work will be done by academic engineers while the men in the shops are confined strictly to workshop manipulation, we shall fall behind relatively. Nations have never been enlightened and progressive, either politically or industrially, where the thinking was monopolized by the few and the work done by the masses.

Prof. Higgins evidently believes, and we entirely agree with him, that shop work is more than a mere handicraft; it is a science of which no one who calls himself an engineer can know too much, and of which many know entirely too little. His proposed school in which each boy having a taste or inclination for machinery shall commence on a common level with others having similar tastes or inclinations, and each go as far as his individual capacity or opportunity will permit in both real shop work and in the book knowledge that is a part of the science of machine construction, would be, it seems to us, nearly an ideal one. It would make the utmost possible out of every boy—put him in the way of becoming a skilled and able mechanical engineer, shop superintendent, foreman, draftsman, or, if none of these, then a good and intelligent workman.

There is a certain class of what may be called "professional professors," who have no natural or acquired taste for or appreciation of machinery or of machine construction. They have attained their positions simply because of what may be called general mental capacity, and would have done about as well in any other walk of life they might have happened to choose. They know as little as possible of shop practice, and really imagine that they look down upon it from a great eminence; as one engineer has said, they look down upon manual training much as the preceptress in a young ladies' seminary might look upon instruction in laundry work for her pupils. She might have them take such instruction, not to make washerwomen of them, but that they might know how it should be done and criticise when necessary with sufficient intelligence to avoid being laughed at.

Not everybody else will agree with Prof. Higgins, but it is pretty certain that the type of professer referred to will not do so. Fortunately, there are other professors, however, and we hope that Prof. Higgins' paper will not only receive the attention it deserves, but that something substantial will result from it.

Help Wanted Advertisements as an Index of Prosperity.

Our issue of October 5 last contained an editorial, with a table of figures, showing the average number of help wanted advertisements published in our columns for each quarter of the past three years, but including, of course, only the three then completed quarters of 1899. As the year has now closed, we have reproduced this table below, with the figures for the fourth quarter filled in, and with an additional line giving the average number of such advertisements per issue for each entire year.

As stated in the previous article, we have long regarded this column of advertisements as an excellent index of the state of activity of the machine building industries, and while no study of such figures is needed to convince anyone that these industries are at present extremely active, such a study is, nevertheless, of interest.

Like most statistical figures, it must be remembered that these do not tell the whole story. A conspicuous feature of these advertisements for some time past has been that many of them have called for a number of men each. This was not the case at the beginning of the period covered by the tables. Since the tables can only show the count of the announcements, and not the number of men wanted, it follows that the real improvement of conditions is materially better than what the comparison shows.

The first table shows the average number of help wanted advertisements printed per issue for each quarter of the years 1897, 1898 and 1899, and in the last line the average number per issue for each entire year. A comparison of these figures is most gratifying, and in addition to the general improvement as compared with previous years, it shows conspicuously

that, instead of the usual lull of the summer season, the past year has shown a progressive improvement for the entire year.

	1897	1898	1899
First quarter.....	6	9.1	11.6
Second quarter.....	6.5	9.8	13.9
Third quarter.....	4	8.4	17.
Fourth quarter.....	6.3	10.1	18.5
Entire year.....	5.7	9.35	15.25

While the first table shows clearly the improvement, by actual count, more interesting comparisons can be made on a percentage basis, and in the second table the figures of the first column of the first table are each taken as 100, and the others of each line are enlarged in proportion. This table shows the improvement of corresponding quarters of the three years, each taken by itself, and of the entire years. It does not, of course, show correctly the improvement of the consecutive quarters of the same year, as each line is on a different basis of comparison. The third quarter of 1899 in comparison with the same quarter of previous years shows, of course, much the greater gain.

	1897	1898	1899
First quarter	100	152	193
Second quarter	100	151	214
Third quarter	100	210	425
Fourth quarter.....	100	160	294
Entire year	100	164	268

The third table takes the averages for each entire year as bases by making them read one hundred, and then enlarging the figures for each column in the same proportion as the figure of the bottom line of the column was enlarged. This table is, perhaps, the most interesting of the three, as it brings out strongly the fact of progressive improvement throughout the past year. The lull of the summer season of 1897 and 1898 is again conspicuous, the figures for that season being the smallest of the respective years. While in the second table each year shows an improvement over the preceding one, the third table shows no marked improvement of the later quarters of 1897 and 1898 over the early quarters of the same years. For 1899, however, the figure for the first quarter is the smallest for the year, and from this the improvement is progressive throughout the year, the gain for the fourth quarter over the third being not greatly less than that of the other quarters over those which preceded them, and the gain of the last quarter over the average for the entire year being greater than for either of the two preceding years. The inference from this table is that the tide of prosperity is still rising.

	1897	1898	1899
First quarter	105	97	76
Second quarter	114	105	91
Third quarter	70	90	111
Fourth quarter.....	111	108	121
Entire year	100	100	100

The fourth table puts both lines and columns upon the same comparative percentage basis by taking the average for the entire year 1897 as 100 and then enlarging all the figures of the table in the same proportion. It shows that during the year just closed we published these announcements at nearly two and three-quarters times the rate that prevailed during the year 1897, and that for the quarter just closed the rate was three and a quarter times the rate for all of 1897.

	1897	1898	1899
First quarter	105	160	203
Second quarter	114	172	244
Third quarter	70	148	298
Fourth quarter	111	177	328
Entire year	100	164	268

Advertisements for Men to take the Places of Strikers.

It sometimes occurs, though we believe not often, that people who advertise in our columns for help do so because they want men to take the places of others who have struck, or who may have been "locked out" on account of some difficulty that has arisen. And sometimes, after such advertisements have appeared, we are asked by the men on strike or by the organization to which they belong, to publish the facts of the case. Though we believe that the truth of such matters can do no one an injustice, we have not been able to see our way clear to the publication of such notices, partly because we could not make them to include every case, and if we covered only a portion of them that would be more misleading than to publish none. Besides it is probable that we could be held liable for damages were we to publish any such thing that could be shown to be an injury to any man's business.

At the same time we know that there are often good reasons why a man would not care to go to work in a place where there had been trouble of any kind, and we know that men have in many cases refused to go to work after traveling long distances to reach the advertiser's place, this, of course, doing the advertiser no good, to say the least of it, and the man some harm. We think it would be better for all concerned if those who advertise for help would make a candid and clear statement of the circumstances of the case when there has been trouble, so that there would be no chance for misunderstanding or accusations of unfair treatment.

So long as this is not done, then we think the only practicable course to pursue is for those who answer advertisements to ask if there has been or is expected to be any labor trouble. It is no more than fair and right that both sides should know the facts that have a bearing upon the relations into which they propose to enter..

It is unfortunately true that machinists and their employers sometimes have differences that lead to strikes or lockouts. We do what we can to prevent such difficulties and to show how they may be avoided, and we are glad to believe that machine shops have less of "labor troubles" than are found in most other branches of industry. We hope they will continue to have this distinction.

American Competition.

American manufacturers need not worry much about the attacks that are being made upon their work and their business methods in England, so long as such letters as we reprint below are called out and printed, as this one is in the December 15 issue of "Engineering":

"Sir—I feel reluctantly obliged to reply to the further letter of the British Insulated Wire Company respecting the Dublin United Tramways cable contract, in your issue of last week.

"If their first public letter on the above subject had any object, it was to cast discredit on Mr. Parshall in connection with this contract, and to charge the directors of the tramway company with sacrificing the interests of their shareholders.

"I have stated that the tender of the American company was accepted in fair competition because it was the best offer we received. I repeat, the work, as executed, is more favorable to the company than the original tender, and I am not aware that the Dublin Tramways Company have any obligation to disclose the details of their business to the British Wire Company, further than was necessary for the purpose of their action against the National Conduit Company.

"The British Wire Company think that my knowledge of American electrical engineering must be very limited, but it is wide enough to know that the cable ways and cable system of the Dublin tramways, which are all of American manufacture, form by far the most complete and perfect underground cable installation now in operation in the United Kingdom.

"Yours faithfully,

WM. M. MURPHY,

"Chairman of the Dublin United Tramways Company.

A call for a National Anti-Trust Conference, to be held in Chicago on Lincoln's birthday, February 12, has been issued by M. L. Lockwood, of Zelienople, Pa., and other members of an Executive Committee appointed at a conference held last September. All citizens are invited to attend, either as delegates or in an individual capacity.

At a recent meeting of the Automobile Club of America it was decided to send a challenge for the International Automobile Cup, now held by the Automobile Club of France. The challenge, as sent, will not state names of any of the three competitors which will be allowed from each competing club. The race will not take place until next July.

Commercial Review.

NEW YORK, SATURDAY EVENING,
December 30, 1899.

THE OUTLOOK.

The past year has brought prosperity to ripe fruition. It has been characterized by an over demand and stampede among buyers, and a sharp and far reaching appreciation, or rather, recovery, of values. At the present time of annual transition the market has recovered somewhat from its confusion, but the volume of trade on the books of manufacturers or in prospect is substantially undiminished, so that as far as one can see into 1900 that year will be a repetition of 1899. Prices have shown relatively little change of late, but are generally firm, although there has been a seasonable weakening in the metal markets. After the first of the year the upward movement on raw and finished materials may or may not be resumed. Quotations are in such a mobile state that they will be watched with unusual interest.

One of the most important developments that has taken place in the machine tool line in the last year or so is the enlargement and betterment of producing facilities. In Cincinnati especially a new-plant epidemic has been going the rounds. If it had not been for the export trade which began in 1896, manufacturers would be much less in a position to put up bigger shops, and consequently would be losing the benefit of a great deal of the home trade that they are now caring for. A good many new tool builders have entered the field, too, so that the number of competitors has materially increased, but the volume of business has increased so much more proportionately that we have not heard the faintest growl over sharpened competition.

DYNAMOS AND MOTORS.

Electrical machinery is just where it ought to be at this season. Manufacturers have still as much as they can do in their shops, and the volume of prospective business evidenced by inquiry is practically undiminished. During the latter part of this month, as might have been anticipated, buyers have been indisposed to bring business to an immediate consummation. It is virtually assured that for several months of next year, at least, factory order books will be filled up with abundant new entries as the old ones are canceled. This is true both of street railway and of direct-current apparatus.

Some manufacturers are gaining on their deliveries, while others are holding their own with difficulty, or are running behind. The General Electric Company is doing somewhat better with small machines, but rather the reverse with big ones. Among the direct-current manufacturers one names thirty days for delivery of ordinary work, though large machines would require longer; another concern wants two or three months for other than the smaller sizes. Another yet demands three to four months, while still another company names four months as an average. This last would need four months to turn out a 16-kilowatt machine. Dynamo makers are not yet free from trouble with their sources of material supply. While steel castings can be obtained more readily than in the past, there is a shortage of copper wire and commutator sections to such an extent that some copper manufacturers have turned down orders.

CHICAGO MACHINERY MARKET.

Repair work has been during the past week a much larger element in the trade of belting, shafting, hangers and shop accessories generally. The impression which the inquirers for this work give is that they wish to utilize every inch of floor space which their plants permit, for the opinion is widespread that activity of a superlative character will mark the coming year, and that the shop which is best equipped will obtain all the business it can turn out. In addition to this repair work, there continues the usual amount of new business in shop supplies, making the aggregate for December one of eminently satisfactory proportions.

The American Bicycle Company has lately been a large buyer of machine shop tools and supplies. The purchasing agent in New York has contracted for large supplies for the coming year, and emergency orders by the Western plants of the company direct to seller have also been of fair volume. Few, if any, machines are being bought in the bicycle line, but the supply trade is very large, independent makers of wheels also buying on the scale of former years.

For emery wheels and similar goods the demand during the closing half of December was surprisingly large. Much of this trade was for rush shipments, indicating a scarcity of stock in shop, the explanation being that purchases made some time ago for use during the balance of the year failed to hold out, owing to a consumption rather heavier than anticipated. In various other lines the same urgency has been noticed, and in its totality the machinists' supply trade for the latter half of the month may be said to have been without the usual quiet of this season of the year.

Shafting is as scarce as ever, and prices are unchanged. For small tools no changes in value are noted, but there are intimations that some advances may occur early in the new year, due chiefly to an increased cost of material.

The Chicago Belting Company is running night and day, and at that is scarcely able to keep up with its orders. Last week's sales included belting outfits for three Southern sawmills and two Northwestern flour mills, one of the orders aggregating $5,000.

Armstrong Bros. Tool Company is meeting with flattering success in sample orders for the new special planer tool which it is putting on the market.

PITTSBURGH REPORT.

The closing of 1899 shows a condition never experienced in the history of iron and steel. A comparison of the first week of January, 1899, with the last week of December, 1899, is like the contrast between day and night. Any person who should have remarked twelve months ago that prices would see such advances so soon would have been termed "daffy," and to anyone who asserted that the demand for material, either raw or unfinished, would exceed the producing capacity, the same term would have been applied. A careful review of the different prices of iron will show that Bessemer iron was selling at $10.85 and $11 at Pittsburgh during the first week of January; No. 1 foundry at $11; No. 2 foundry at $10.75 and $11, while mill iron was bringing as low as $9.75 per ton. The prevailing prices to-day for the same materials are $24 and $25 for Bessemer; $25 and $25.50 for No. 1 foundry; $23.25 and $24.25 for No. 2 foundry; $20.25 and $21 for mill iron.

Mills have sold their production for the first six months of 1900, and in some instances sales have been made for the third quarter at the prevailing high prices, thus showing that there is much confidence for a continuation of the big business. There have been a few shutdowns of plants in the Pittsburgh district for repairs. It is the usual custom to take two weeks for a general overhauling of the works, but this had to be dispensed with at the present holiday season, as there were too many orders to be filled to allow such a thing. The American Steel Hoop Company had ordered a ten-day lay-off for repairs, but countermanded the order before the vacation was begun. The same has been the case with many other of the iron and steel manufacturing concerns.

Foundries and machine shops are running to the utmost capacity, every workman to be secured is put to work, and overtime is general. The only way out of the difficulty of meeting the demand for material is to enlarge the plants, but this cannot be done with any degree of rapidity when it is known that the structural material is very scarce and the prospect for securing the necessary equipment for the works is very slim. Some of the heavy makers of cranes are stating terms of delivery at six and eight months, and engine and boiler manufacturers are asking three and six months for shipment.

Whoever attempts to secure second-hand machinery will meet with various kinds of obstacles. Those who have had second-hand equipment for sale have secured fancy prices, and no doubt would receive fancier prices if they had the material at the present time.

The American Steel and Wire Company, which is building an immense steel

plant on Neville Island, near Pittsburgh, closed all the contracts for the equipment last September, and is now going ahead with the new works, which will be of large size. The location secured for a plant of this character is an admirable one, and has been in demand for some time past.

The Duquesne Steel Foundry Company, recently organized in Pittsburgh, has practically decided upon a situation, but will not divulge the site until after the company is fully officered and completely organized. No contracts have been awarded for the plant, which will be of good size.

At the present time a company is in process of formation to be known as the American Pipe and Foundry Company, which will manufacture cast iron pipe. It is understood that William B. Scaife, of Pittsburgh, is interested. The Union Switch and Signal Company is now receiving bids for the erection of its new buildings, which will be of steel. Contracts are to be awarded in a short time.

PEABODY & CO. ON EXPORT TRADE IN TOOLS.

The views of Henry W. Peabody & Co., of this city, on export trade in machine tools were obtained this week by a representative of the "American Machinist." This firm, whose high mercantile standing is well known, and which has branches in various quarters of the world, is handling a considerable quantity of the American machinery and supplies now going abroad, for some of which it holds agencies.

It believes the machine tool export trade of the past year to have exceeded that of 1898 by an important percentage. The last few weeks have been relatively a quiet season; this is attributed to the approach of stock taking time, which affects foreign trade as well as domestic, and to the high prices that are prevailing in this country. The advances made are regarded as having been a severe blow to export trade, and it is stated that they have not been met by equal increases in Europe. Some of our competitors there have raised figures only about 5 per cent., against 25 on this side of the water. Imitation of American tools in Germany has been carried to such a point that machines are now met with there which are practically on a par with ours, except that they cannot be given the same finish at as low a cost—or rather could not if our manufacturers had not surrendered their economic advantage by their advances in prices. Further increases than what have been already made would probably be signally disastrous, and it is not believed that our manufacturers will go much higher, but rather that values will hereafter subside. An indication that such will be the case is the fact that an Eastern tool manufacturing company, which has previously been so busy that it had little time for soliciting orders, is again looking around for them eagerly. Phenomena such as that do not evidence a business atmosphere favorable to inflation of values.

Among the most extensive fields of Peabody & Co.'s machine tool business are Germany, Italy, Sweden and Russia. The Russian market is considered to present the best future. It is not one that can be worked up in a year, but the extent and resources of the empire promise great things for it as a market eventually. Our French trade is handicapped by high duties and by the lack of proper discrimination between fine and heavy machinery.

Among the types of tool for which there is a foreign demand attention is drawn particularly to boring mills. It is the vertical mills of 3, 4 and 5 feet which are most in requisition.

Foreign houses would appear to have stocked heavily with tools, for it is rumored that one of the prominent Continental ones has now such a stock, either abroad or under contract in this country, that a change for the worse in the condition of the market would leave that firm in a very uncomfortable position. The experience of Peabody & Co. goes to show that deliveries of light tools are becoming easier, but that heavy ones are still very slow. A company in one of the Middle States, for instance, was unable to promise a delivery on certain work much before the end of 1900.

One lesson which some of our manufacturers have yet to learn is how to pack machines for foreign shipment. They ought to be boxed much more substantially when they are intended for trans-Atlantic shipment than if their journey were only from Cincinnati to New York. It is said to be practically impossible to hold the transportation companies responsible when accidents occur.

The views of Peabody & Co. on packing machinery—a subject upon which they certainly can speak with authority—may be supplemented by a little information which has come to notice. It appears that the fault is not always the manufacturer's. A tool made by a Cincinnati firm was being hoisted on board ship not long ago, when the chain broke and let it fall, breaking it. Fortunately the part broken was interchangeable, and could be replaced from the stock of the New York agent. Another tool manufacturer states that even where directions are explicitly inscribed on a case to undergird it in two places when being lifted, a single chain will sometimes be used in trans-shipment, and the case, not being intended for this, will be crushed in.

MISCELLANEOUS.

Awards have been made of the machinery and tool contracts for equipment of the new steam engineering machine shop at the New York Navy Yard, based on bids opened October 10. On 55 out of the 167 lots in the specifications no award has been made, and it is stated that the tools will not be required, which would indicate that from lack of funds, or for some other cause, the plans of the Navy Department have been narrowed down. Manufacturers will in most cases have ample time for delivery of the machines, since the building will not be ready for them until next September.

The Arthur Company Machine Works, 188-190 Front street, New York city, report a very lively, growing business. During the last quarter of 1899 they added four lathes, three drilling machines, two milling machines, a keyway cutter and a punching machine. In addition to this, they have been running for a month two 6-foot gear cutters of their third, and latest, design. So marked is the success of these two machines that they are now building two more of still heavier proportions, but same type, to be added to their gear department about April 1. The company notices no slackening of demand because of the season of the year. The activity of the country's industries in general appears to them so excessive that they are suspicious of its permanence. Speaking in detail of their trade, which is chiefly domestic and largely a New York city one, they refer to steam specialties as a particularly active line.

Quotations.

NEW YORK, TUESDAY MORNING,
January 2, 1900.

With a strong domestic situation and bullish cables, the iron and other markets are opening buoyantly this morning, and the first indications of the new year are for a continued upward movement in prices.

Iron—American Pig, tidewater delivery—

Pennsylvania Irons:

No. 1 X foundry	$24 65 @ $26 65
No. 2 X foundry	23 65 @ 24 15
No. 2 plain	22 65 @ 23 15

Alabama Irons:

No. 1 foundry	22 75 @ 23 00
No. 2 foundry	21 75 @ 22 00
No. 3 foundry	20 50 @ 21 00
No. 1 soft	22 75 @ 23 00
No. 2 soft	21 75 @ 22 00
Foundry forge	20 25 @ 20 75

Bar Iron — Base sizes — Refined, mill price on dock, 2.20 @ 2.36c.; store price, 2.55 @ 2.60c.; common from store, 2.50c.

Tool Steel—Base sizes—Standard quality, 7 @ 8c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—Ordinary brands from store, 2.90 @ 3c.

Cold Rolled Steel Shafting—Base sizes—From store, 4 @ 4¼c. in small lots.

Copper—Lake Superior ingot, 16⅜ @ 16½c.; electrolytic, 16 @ 16¼c.; casting copper, 16 @ 16⅛c.

Pig Lead—Wholesale lots, 4.65 @ 4.70c., New York delivery; carloads, 4.72½ @ 4.75c.

Pig Tin—In 5 and 10-ton lots, f. o. b., New York, 26¼ @ 26¾c.

Spelter—Prime Western, 4.55 @ 4.60c., New York delivery.

Lard Oil—Prime City, present make, 45 @ 47c. in jobbing lots.

4½-foot Semi-Universal Radial Drill.

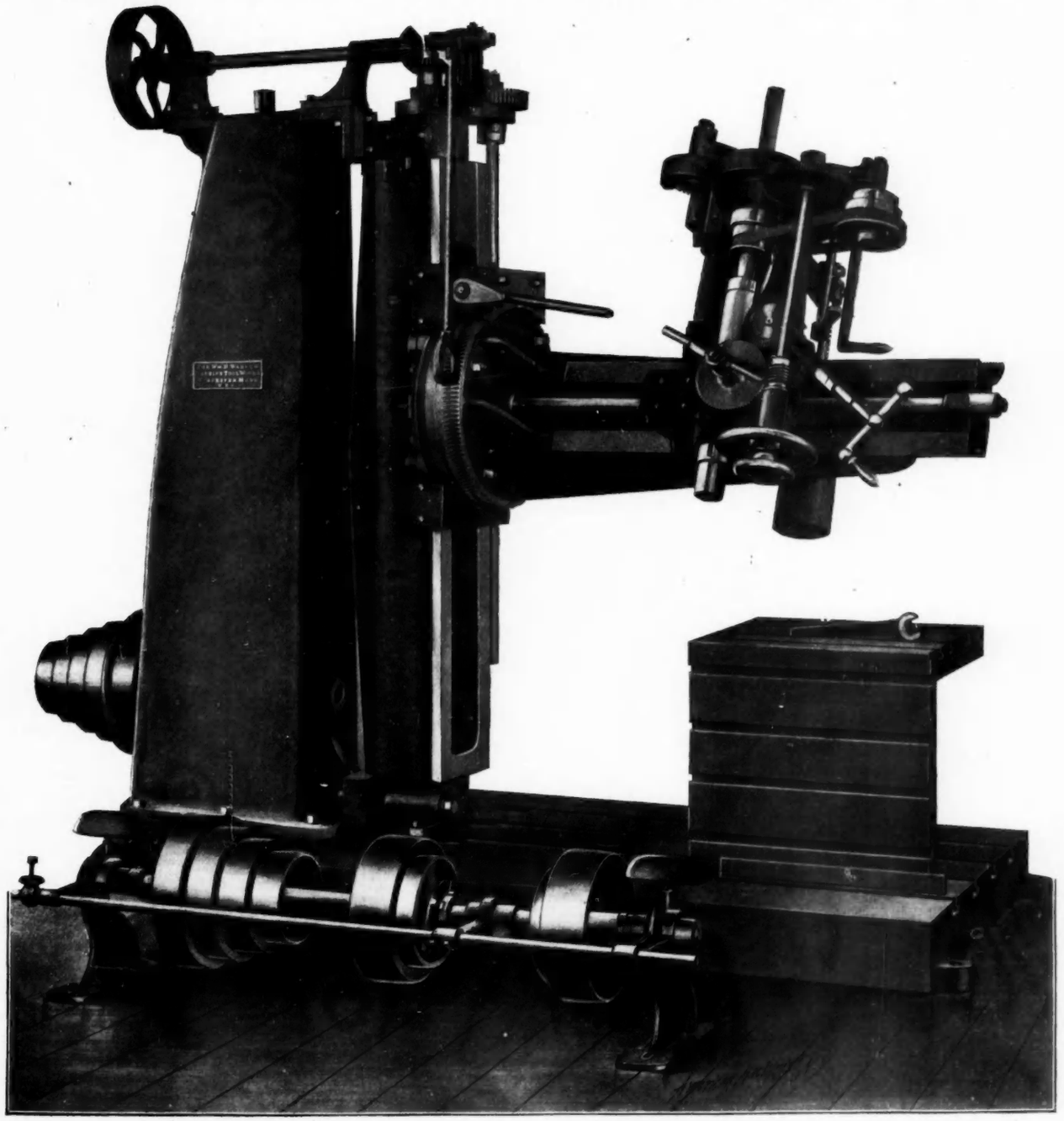
The radial drilling machine shown by the accompanying engravings is intended for drilling and boring, and as its arm may be revolved entirely around upon the saddle by means of the worm gear cut upon the periphery of the flange, and the arm may be lowered within 24 inches of the base-plate, horizontal boring of heavy pieces may be readily accomplished. A pivoted upright separate from the column is provided, and the weight of this and its attached parts is borne upon eighteen ⅞-inch steel balls.

The arm is moved vertically by power, and the spindle saddle is moved upon the arm by the rack-and-pinion movement with angular crank-shaft seen in the photograph.

The approved practice of placing the back gears at the spindle is adopted, which enables all shafts and gears that merely transmit motion from the cone pulley to the saddle to run at high speed and to be subjected to little torsional stress.

At Fig. 2 is an end view and section of the arm and saddle, and at Fig. 3 the arrangement of gears showing how by the movement of the lever seen above the arm and at the right of the spindle saddle two ratios of gearing are obtained, one of which gives two turns of the spindle to one of the cone; the other, slightly more than 9. The shifting lever referred to is attached to the triangular frame at *A*, which carries the shifting gears and is pivoted at *B*.

In the position shown by the heavy lines the drive is from gear *C* through gears *D*, *E*, *F* and *G* to *H*, and the ratio is 1 to 9 3-16. In the position shown by the lighter lines the drive is from *C* through the intermediates *I* and *J*.



4½-FOOT SEMI-UNIVERSAL RADIAL DRILL.

The feed mechanism will be readily understood from the photograph, where it will be seen also that the usual facilities are provided for handling the machine.

The counter-weight slides upon a fixed rod, so that its motion is always parallel

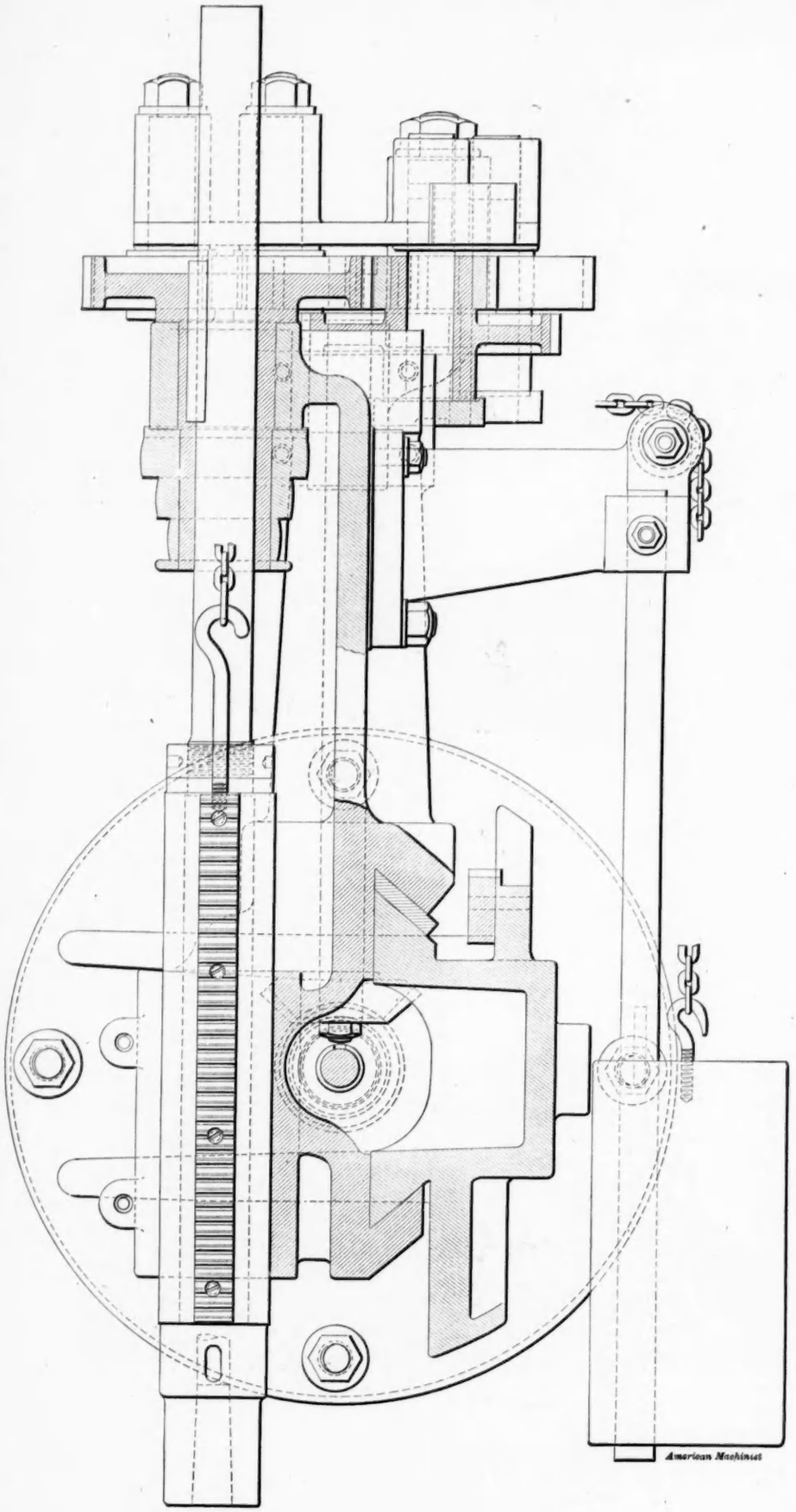


Fig. 2

END VIEW AND SECTION OF ARM AND SADDLE.

to that of the spindle, which is thus not overbalanced when working at an angle. The spindle is 1 15-16 inches diameter above the sleeve, and the latter is 2¼ inches diameter. It has a traverse of 16 inches, and has a Morse No. 4 taper hole. The greatest distance from the center of the spindle to face of column is 56 inches, and from end of spindle to base-plate 55 inches. The cone is for a 3-inch belt, and the machine weighs, complete, 9,500 pounds. It is made at the Wm. H. Warren Machine Tool Works, Worcester, Mass., which is now owned by the Garvin Machine Company, of New York.

Design of Automobiles.

BY M. C. KRARUP.

According to the plan almost universally adopted for motor vehicles, the weight of the power source and motor is supported by the same axles and wheels that support the weight of the driver, passengers and load; the rear axle is rotated by the motor power through gearing or belt, and the propelling power is transmitted through the wheels and applied against the surface of the road. Steering is effected by the driver using main force to turn the front wheels around vertical pivots that carry horizontal stub axles for the wheels.

These are points of radical difference between the automobile and horse-drawn vehicles, but it is safe to say that they do not exist by express intention of automobile constructors, but have merely followed from a natural inclination to make the automobile conform as nearly as possible to the customary outlines of an ordinary vehicle. If they serve the purposes of an automobile, it is by accident. It is interesting to note how many important chances for errors in other construction details spring from these differences alone, and how few of them have been considered in relation to our road and street conditions and the requirements of our public.

These simple points go far to explain the many breakdowns of automobiles that have been noted during the past year, and are therefore of special interest, although automobile constructors as a rule have considered them as of inferior interest compared to the problems of the motor and the transmission gear between the motor shaft and the wheel axle. And in reality these latter problems are perhaps of superior importance where the roads are uniformly excellent.

I do not agree with the commonly prevailing opinion that the proper construction of an automobile is a matter of ordinary mechanical engineering and machine design, and may be accomplished through the mere application of already acquired knowledge. In place of this supposition, according to which perfect automobiles might make their appearance any day, it is desired to show that experience in the

art of building them must overbalance science in importance when it comes to building automobiles for American conditions, and that therefore a considerable time must elapse before automobiles may be produced that will be thoroughly acceptable to anybody but enthusiasts, unless some phenomenal genius happens to strike the right solution by one miraculous stroke; and the chances for that are at all times and in all cases exceedingly remote. They are made still more remote by the fact that not one but several dozens of automobile types of vehicles, presenting essential variations, must be evolved before the horse may be considered as successfully supplanted in its principal fields of work.

The strength of the ordinary carriage, buggy, spring wagon, etc., to resist the knocks dealt by bad drivers, bad roads and unruly horses is a good deal like the strength of the bamboo hut, which sways to the blow of the hurricane, but still stands after the blow is over, while the stone mansion collapses; or like the strength of the thin glass which escapes breakage and injury in the careless hands of the kitchen mechanic, while the thicker one chips off on the edges at the slightest jar against a hard substance and cracks from inner tension when it is exposed to heat and cold unevenly. It is the strength of elasticity, the strength in yielding. It depends on a certain degree of thinness of material, certain proportions in dimensions and upon the choice of materials used in construction. Many things pertaining to the art of incorporating the strength of elasticity in carriages and other structures in which it is required, have been learned solely by experience, and have not yet been scientifically mastered. They are not booked in the manuals of engineers, but an understanding of this factor and a happy knack of applying it correctly have often spelled the difference between failure and success among architects, bridge builders, carriage makers and others, and is of greater importance the more varied and incalculable are the strains to which the structure is subjected. While architects and bridge builders have mainly to figure with loads and wind velocity, builders of carriages and automobiles must take into consideration such factors as weight and load aggravated by speed, turns, impact with the inequalities of bad roads, up and downhill work; and they are furthermore handicapped by the esthetic requirements of the public in regard to design and outlines. What is of greatest interest in connection with the subject of automobiles is the enormous disadvantage under which automobile makers labor as compared to carriage makers in this respect, on account of the greater weight of the structure, the higher speed expected of it, the consequently very highly increased force of all impacts and shocks, and the additional strains arising from the workings of the power mechanism.

Everybody who has given any thought to the mechanics or art of carriage building knows that the questions pertaining to design and material are most intimately mixed up with the requirements for elastic strength and that there comes a point in the dimensions of any construction part—of a given material and form—where it becomes impossible to combine the required elastic strength in said construction detail with the brute strength that may also be required of it. It would break if thinner, and it would be too unyielding if thicker. If such a case arises, it may be necessary to choose a new material by the use of which the two requirements may be combined; for the pro-

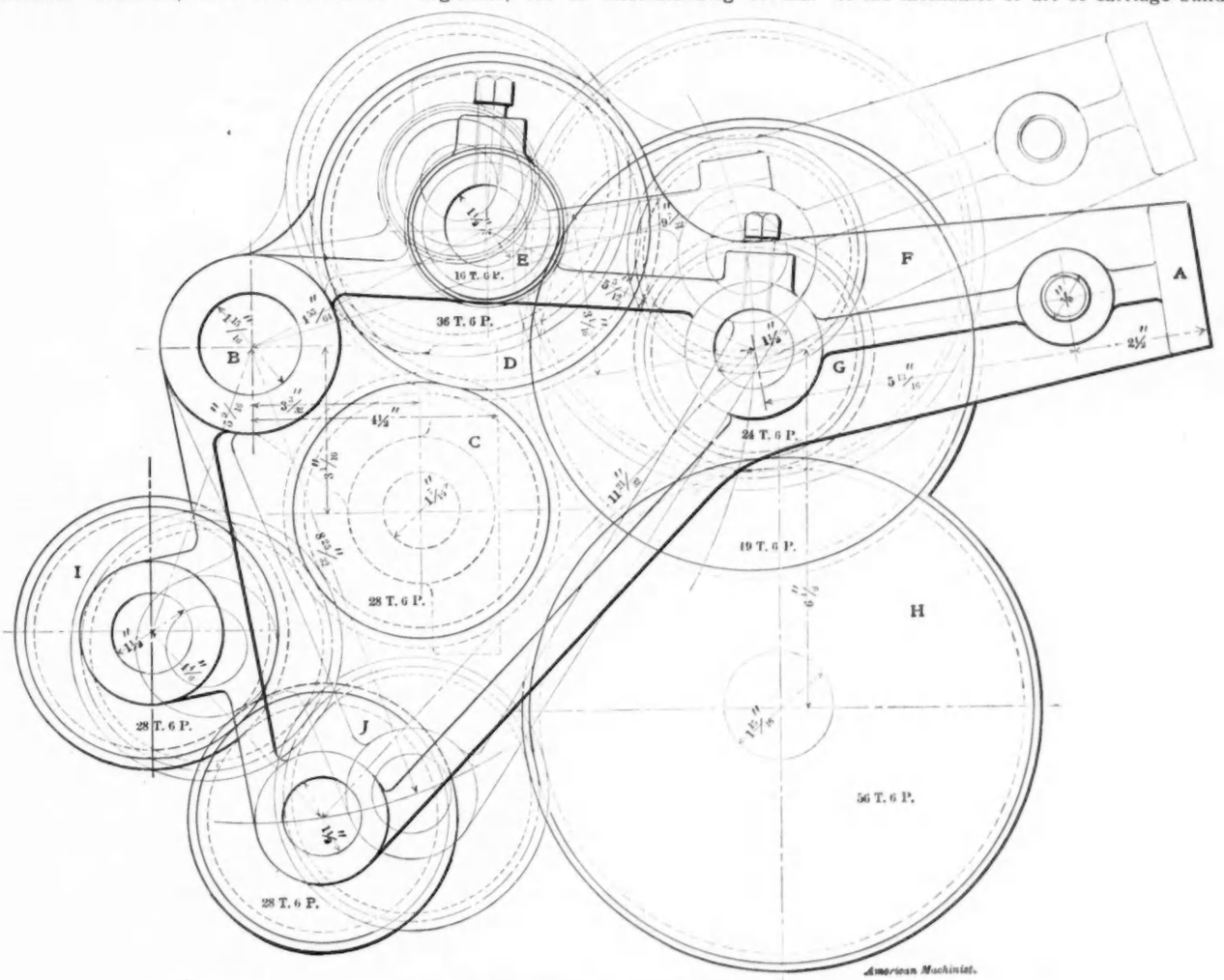


FIG. 3. SPINDLE BACK GEARS AND BRACKETS.

portions vary largely according to the nature of the material that is used as well as its form.

The easiest way out of difficulties of this kind is to sacrifice the elastic strength and add sufficient to the brute strength to resist all shocks. That is what was done before springs were used for carriages, and what is still being done in cheap carts for rough work. It is also being done by that school among automobile builders who believe in making the automobiles "so heavy that they will not bound over a rough road." But by following this easy principle, which testifies to a certain mental indolence in its adherents, carriages become clumsy and heavier than necessary. In ordinary carriage building, the preference in the United States has been decidedly for the opposite principle of making every part as thin, elegant and light as possible, and by the ingenuity of the construction to ease the strains on any one part. It is by following this principle that American carriage builders have earned the reputation of making the strongest and at the same time the most elegant carriages in the world. They have been assisted in reaching this proud position through their fortunate access to the use of hickory wood, which has greater tensile strength than any wood native to Europe. Lately new developments in the same direction have been due to the introduction of steel tubing, aluminum and rubber.

It does not seem likely that the prospective buyers of automobiles will be willing to forego the demand as to combined strength and style to which they have been accustomed in horse-drawn vehicles. But to introduce this desirable combination in automobiles so long as the present plan of construction is followed, meets with serious difficulties which are not usually realized by the public, and which are shoved aside by constructors as being of no consequence in comparison with the inestimable boon of getting rid of the horse. When it is desired to form a sober estimate of the probable progress of automobilism, they must be considered, however.

Proceeding in due order, reference is here only had to the effects of placing the power source and motor in the vehicle and thereby increasing its weight, and it may be premised as self-evident that all difficulties which arise from this cause must be infinitely more serious for vehicles intended to travel over poor roads where the occasions for violent bumps are numerous than for vehicles that may be used over smooth roads exclusively; so that it is quite within the range of possibilities that a French vehicle may be a success in France at a weight of 3,000 pounds, and a vehicle built on the same general plan may be an absolute failure in the United States even at a much lower weight. In this connection it is especially noteworthy that on good roads the strains in a vehicle follow regular lines and planes, along which the necessary strength may be readily provided without much addition of material—as in a bicycle, where the strains are mostly in the plane of the machine—while on bad roads the strains are utterly irregular and must be provided against in all directions, necessitating an enormous addition of weighty material, unless, indeed, the skillful constructor knows how to provide what has here been called elastic strength whereby the strains are distributed over a large quantity of material and absorbed in it, instead of being transmitted through a rigid construction and massed—according to the direction and nature of the shock—at any one of a number of different points, each of which must be fortified against the entire original shock.

In railway coaches and street railway cars this may be done by dividing the structure into rigid portions flexibly connected by springs, thus absorbing shocks in the latter, or by buffers, but it is only the comparative regularity of the shocks received by rail travel that permits this arrangement. It is readily seen, for example, that under conditions that would twist a railway coach so as to center a shock in one side of one of the supporting trucks instead of in both sides of two, on a well-ballasted track; either the coach body would need to be made flexible or the springs in each of the trucks would need to be very much strengthened, thereby increasing their weight and diminishing their usefulness for absorbing lighter shocks.

In automobiles it is evident from this parallel that a similar construction plan, consisting in dividing the automobile into large rigid portions, comprising (1) carriage body, (2) the rear wheels and axle and (3) the front wheels and axle—rotatable for steering, but otherwise a rigid whole—with springs interposed between these portions, may be successfully employed only on roads nearly equal to rails as a travel surface. For only on such a surface may irregular strains be averted, and on a rough surface these irregular strains would attack each spring, each wheel and the carriage body as a whole (through the power mechanism and its connections L) with such force that the necessary strength to resist it might only be brought about by a considerable addition of material all over the structure, thus adding still more weight besides that which comes from placing the power source in the vehicle. And it is precisely on rough roads that weight counts heavily to increase the work of propulsion. In other words, in order to propel the thus increased weight, the motor power should again be increased, and this again means more weight, and so on with infinite pyramidally-rising necessity for greater clumsiness and heft. In this sense it may truly be said that weight begets weight. If, on the other hand, an attempt is made to strike a middle course in the construction plan by introducing some degree of elasticity and flexibility in all portions aside from the springs, and especially in the carriage body, the innumerable possibilities for shocks in unforeseen directions, on rough roads, makes it a very uncertain thing what particular spot of the structure will be attacked, because by abandoning the system of absolute rigidity of portions of the structure, the possibility has been opened that the shock may attack a part that has not been fortified to withstand it, either by its bulk, the nature of its material, or by flexibility and flexible connection with other portions of the structure.

In horse-drawn vehicles all these possibilities have been obviated through the growth of the art of building carriages. Comparative perfection in their construction has been reached by purely empiric methods and cannot be transferred to automobile building. The weight placed in the latter and the new strains arising from having power in the vehicle instead of outside of it, render the problem of constructing them on the flexibility-all-through plan an essentially new one which in all likelihood must be solved by a persevering study and protracted experimenting with new materials to take the place of wood, because wood, in order to be strong enough to resist some of the strains in a heavy vehicle, must be of large dimensions, and when of large dimensions loses its flexibility and adaptedness for distributing other strains arising from shocks of other kinds against which precautions must also be taken.

The only method by which prolonged experimenting may be partially avoided is, as above shown, to adopt the plan of absolute rigidity in each of the main portions of the automobile, accepting great weight as unavoidable. This is the most obvious plan that suggests itself to the orthodox engineer who undertakes to design an automobile in conformity with his mechanical formulas, but even the lay reader will readily understand from the foregoing that the vehicle thus scientifically evolved is, after all, only a good-roads vehicle. Only good roads present the known factors with which the orthodox engineer may figure; while to construct a vehicle for all kinds of roads, and the many unknown factors arising from them to upset calculations, requires art—consummate new-vehicle-building art, and consequently prolonged experimenting and patient application of the "cut and try" principle.

It might be objected that the carriage-building industry is not solely concerned with light, elegant, flexible carriages, but also produces heavy vehicles designed for heavy loads, and that the automobile builders might pattern after these, and thus acquire the art of motor vehicle construction with one bound, saving an unprofitable apprenticeship. But this con-

solation is illusory, for heavy horse-drawn vehicles are not intended for high speeds as are those automobiles which would equal them in weight; and automobiles intended for heavy hauling at slow speed would be still very much heavier than the horse-drawn vehicle intended for the same work.

So long as the present lines of automobile construction are followed, each style of automobile must remain much heavier than the style of horse-drawn vehicle intended for the same purpose, and no profitable parallels may therefore be drawn from the construction of one to the construction of the other. This truth becomes still more conspicuous to the intuition when it is remembered that the distribution of material is entirely different in the two classes of vehicles, owing to the load of machinery in the automobile and the radically new strains that spring from applying the power at the rear wheel rim in automobiles, instead of at the front wheel hub in horse-drawn vehicles, and also other strains due to the different steering methods.

Some additional reasons should perhaps be pointed out why there is little hope for the deliberately-heavy "scientific" vehicle favored by the orthodox engineer, as above referred to. This style is admittedly a possibility for good roads, and that is certainly something to boast of; but aside from this limited usefulness —which is being thoroughly exploited in France, in the Panhard-Levassor construction especially—it has few chances for success in the United States for any form of pleasure vehicle, because weight and bad roads are two factors that aggravate each other mutually, and when the requirement of speed is added as a third factor, the combination becomes outright impossible.

It being understood that in its safest form this style of vehicle consists of rigid portions flexibly connected by springs, substantially as above described, it is first noted that a shock from the road may have to be sustained by any one of these springs alone, and they must therefore be made so strong and stiff that they will afford very little protection for wheels, axles and motor mechanism (while occupants may be protected by special spring-supported seats) against the constant succession of smaller shocks associated with common-road traveling and the vibrations set up by the same, and by this constant trembling, machinery and wagon-work are rapidly deteriorated and a new necessity created for still further increasing dimensions of material and weights in order to resist it.

It is true that in one of the heaviest American gasoline carriages, made in Holyoke, Mass., a system of auxiliary springs has been introduced, with the effect that small shocks are absorbed in the weakest springs, and the other stiffer springs begin to operate in each case only after the resiliency of the weaker springs has been exhausted; but this is at best only an exception from the general rule, and, as such, shows, moreover, that necessary details even in this heavy form of construction have not yet been worked out by the majority of its representatives in the industry.

Another factor operating against the heavy good-roads vehicle of the usual type is the impossibility of providing much lateral flexibility between the wagon box or carriage body, containing the motor, and the rear axle. The power transmission gear operating between the motor shaft and the axle does not permit much twisting—if it consist of sprocket and chain or gear wheels, as usual in American automobiles—and a sideways jolt which should ordinarily compress one of the rear axle springs and distend the other now transmits a strain to the transmission gear and the carriage box, involving manifest danger of disrupting some portion of the structure, unless new material be added to prevent it.

With belt-driving this drawback is of course avoided, and with electric carriages it does not exist, because the power transmission is by wire to the motor on the rear axle; but it does exist in the majority of American gasoline and steam automobiles and interferes with the benfits to be derived from the rear springs, and these benefits are the more indispensable the less reliance may be placed in the evenness of the road surface.

Usually large pneumatic tires are the expedient chosen for mitigating the strains referred to, as well as all other strains arising from rough roads, it having been accepted as an axiom—transmitted from cycledom, it seems—that pneumatic tires are well adapted for this purpose. And, in truth, it may be admitted that the heavy good-roads automobile, when used on poor roads, stands more in need of a resilient tire than any other moving thing; but it is unfortunately also a fact that no pneumatic tire has yet been invented the material of which will endure the strains of, for example, serving to stop suddenly, by ground friction, a heavy automobile on a down-grade curve. The use of rubber for the tires of very heavy vehicles is purely in the experimental stage, so far as economical usefulness to the owner of an automobile is concernd.

The most rational method so far devised for obviating twisting strains on motor and gear parts, and at the same time perhaps economizing weights somewhat, consists in hanging the motor on the frame of the vehicle rigidly connected with the rear axle, thereby removing its weight from the carriage body and the springs supporting the same and also gaining carrying-space in the wagon box. There is nothing to hinder the employment of special springs for the support of the motor in this position, and the method would undoubtedly be adopted by all designers of heavy automobile vehicles, were it not for the intolerable inconveniences that accompany it and the general unsightliness of the construction. Among the inconveniences it may be mentioned that the design compels slight repairs and adjustments of motor parts to be made by the operator lying flat on his back, reaching upward, and likely to receive scalds from hot lubricating oil dropping on to his face. This laughable spectacle is, however, often witnessed in Europe, where this design has been in considerable favor, probably chiefly with a view to the increased carrying-capacity of the vehicle.

A Novel Experience with an Index Plate.

The accompanying line engraving shows an index plate of special construction used in connection with the indexing mechanism of bicycle chain making machinery at the works of the Pope Manufacturing Company.

The size of the plate was such as to make it of doubtful expediency to use hardened steel in its construction, and at the same time the amount of usage to which it was to be put was so great as to make hardened work very desirable, and hence it was decided to line the notches with hardened plates, the plates being held in place by through-bolts and by locking wedges and screws, as shown. The cast-iron center was cut by the Pratt & Whitney Company, the order calling for a high degree of accuracy. The lining pieces were put in place by a tool maker at the Pope Works, and after completion the plate was subjected to tests for accuracy by a novel fixture designed for that purpose, which provides micrometer readings for comparing the various spaces. This fixture and its use in producing correct hardened index plates we expect to illustrate in the near future. Under these tests the plate was found to be extremely unsatisfactory—in fact, not usable for the purpose. Investigation showed that the plate had been cut with great care, and had been tested without the liners by a satisfactory apparatus, and had shown up well under the test. As the lining plates were known to be alike, the final result seemed at first mysterious. Investigation showed that the tool maker in inserting the plates had screwed the binding screws firmly home, each in succession around the circle, and it was suspected that this had stretched the metal of the plate and so destroyed its accuracy, the errors accumulating with the insertion of the pieces and finally showing as a very serious error in the last space. Investigation showed this to be the fact, and Mr. C. D. Rice, who had the work in hand, directed that efforts be made to correct the spacing by giving different degrees of pressure to the various screws, the testing apparatus being the one already referred to. This was done with a resulting accuracy far in excess of

the plate as first made, without the lining plates. On this point Mr. Rice states that "in my belief, we attained as great a degree of accuracy as it is possible to attain in actual practice in any other known form."

This story teaches anew the extreme flexibility of cast iron—a lesson which, of all lessons, is perhaps the hardest a mechanic has to learn. We say this because those of the widest experience constantly find themselves surprised at some new illustration of the fact, and so long as one is thus surprised, the lesson is not thoroughly learned. It should be constantly borne in mind that whenever any stress, no matter how small, is put upon a piece of metal, that metal yields to it in greater or less degree.

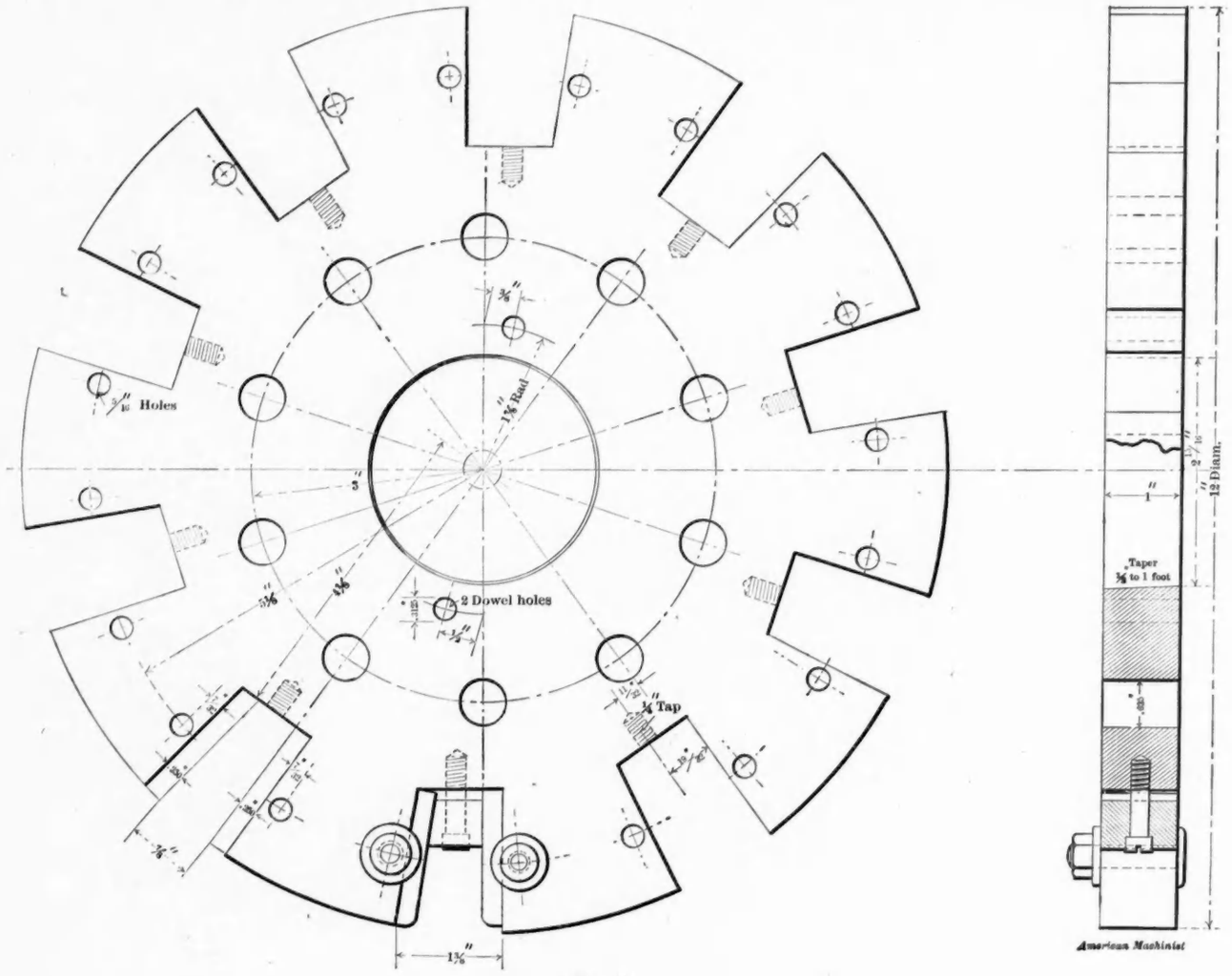


Fig. 2

A NOVEL EXPERIENCE WITH AN INDEX PLATE.

A Proposed New Tax on Patents.

The manufacturers of the country should seek the defeat of the measure just introduced in Congress by Mr. Reeves, chairman of the House committee on patents. Under the terms of this measure any persons or corporation that shall manufacture any article, machine, device or thing hereafter patented shall pay into the hands of the Commissioner of Patents for each of the things so manufactured, as a royalty for the privilege of manufacturing and selling such patented article, a sum of money not less than 1 per cent. nor more than 10 per cent. of the estimated cost of manufacturing such patented article, which royalty will be determined by the Commissioner of Patents. Upon receipt of this sum the Commissioner will issue a stamp or certificate showing that the royalty has been paid, and this stamp or certificate shall be attached to such manufactured articles where practicable, and in all cases shall be delivered by the manufacturer to the purchaser, whether attached thereto or not. No manufactured article will be allowed to leave the hands of the manufacturer without the stamp or certificate.

This we consider to be one of the most foolish and ill-considered measures that have been proposed in Congress for some time. There are too many people who know nothing of the science of taxation, who seem not to know who finally pay all taxes, and imagine that whenever any man or class of men are wealthy it is the duty of somebody to devise a new tax to be applied to them or their business. The proposed tax would be an annoyance to manufacturers, would operate to prevent new inventions from being introduced, and would of necessity be paid in the end, not by manufacturers, but by the users of the particular patented articles, just as users pay all other necessary elements of the cost of producing such articles.

Then, too, let us imagine, if we can, the difficulties and entanglements that would arise from the fact that the Commissioner of Patents is to decide whether a man pays 1 per cent. or 10 per cent. tax.

A new alloy is being used in Paris in the construction of the bodies of automobile vehicles. It has been used by De Dion and Bouton, and has been given the name of partinium. It is an alloy of aluminum with tungsten, and gives a metal with a specific gravity of 2.89 when cast and 3.09 when rolled. It is said to be stronger than aluminum, and almost as light; it is also less expensive.

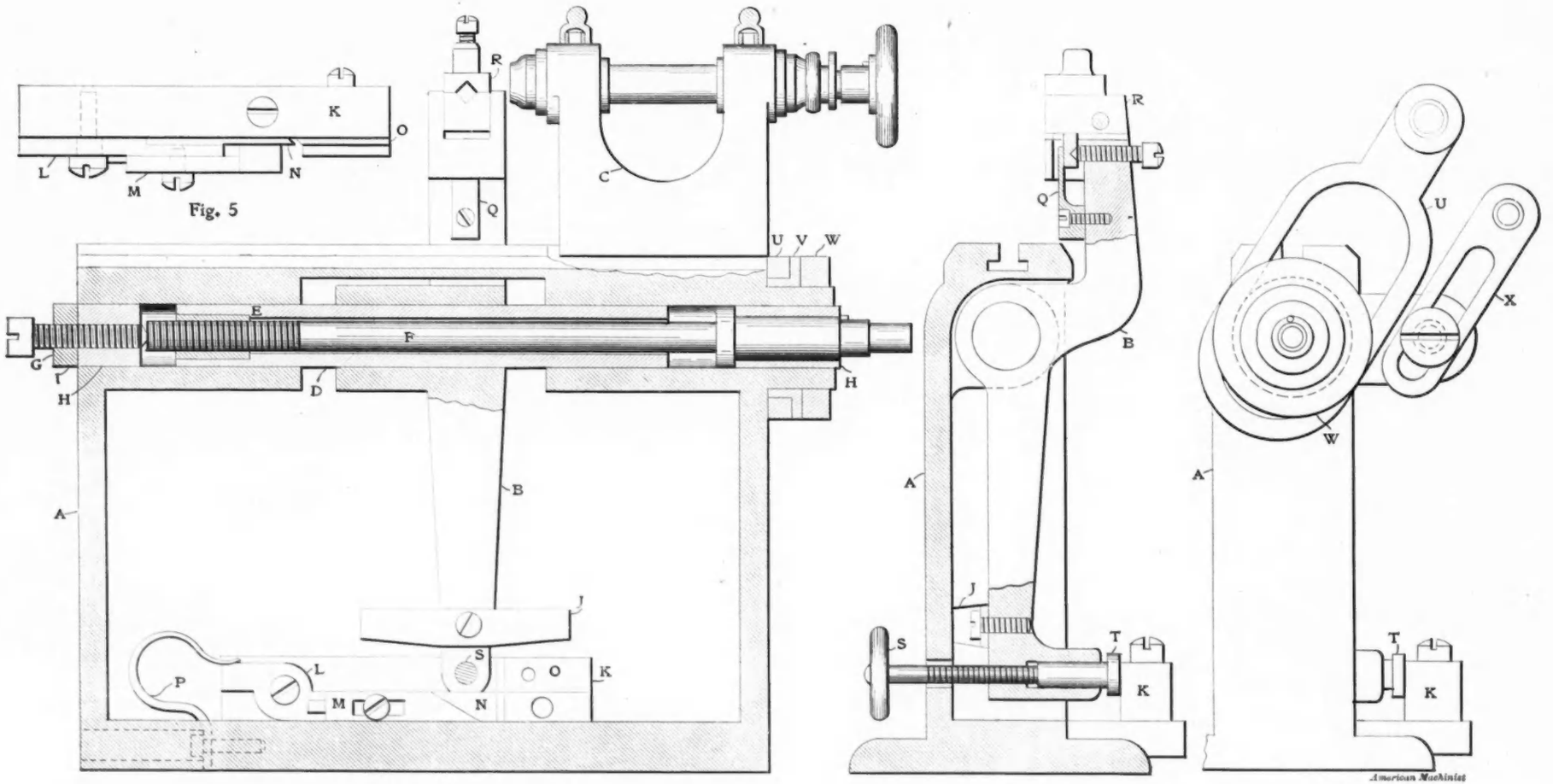


Fig. 5 Fig. 1 Fig. 2 Fig. 3

A TAP THREADING LATHE.

A Tap-threading Lathe—Threading Tools and a Grooving Fixture.

The lathe described in the following article is for cutting small taps with fine threads; sometimes between 200 and 300 to the inch.

The casting *A* is the body of the machine, and B is a pivoted tool-post. This tool-post is carried with the arbor *E* on the lead-screw *F* running in a nut in the end of *E*. At the threaded end of *F* a screw for end-thrust is seen which enters a threaded bushing in the casting *A*, and is locked with a check-nut *I*. This bushing *H* and a similar one, but smooth for a bearing, are held in place by pin-point set-screws, not shown. The tool-post *B* is secured to the arbor *E* in the same manner. By removing these set-screws all of the round parts, *E*, *F*, *H*, *H*, can be readily taken out. *E* has long bearings in *A*, as shown, and carries *B* laterally, while it permits the latter to rock as required.

The lathe-head *C* is a regular hollow-spindle one, with draw-in spindle for spring or solid chucks; and the draw-in spindle furnishes the stud, in screw-lathe parlance, for the first gear.

Referring to Fig. 2 for the plainest view, *R* is a rocking tool holder, rocking on a pin, and is provided with a set-screw for adjusting the tool-point up or down, and the flat spring *Q* keeps the holder against the screw.

The depth of the thread tool when cutting is regulated by the sliding stud *T* in conjunction with the adjusting screw *S*, which moves sideways in an oblong slot in *A*, as the tool-post *B* travels forward and back.

The automatic device for letting the thread-tool out and in is shown more completely in Fig. 1 and in the detail view,

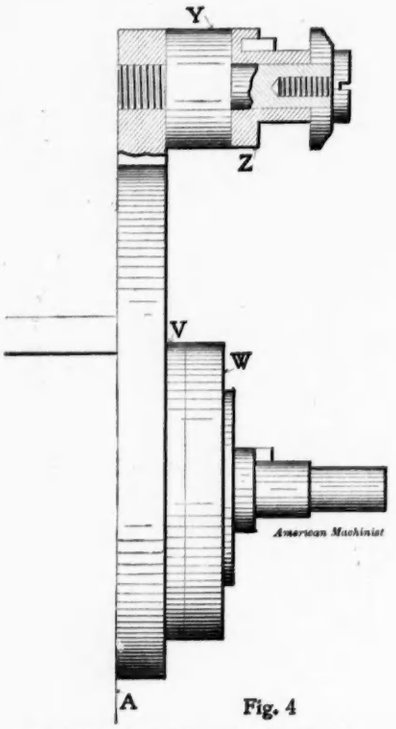


Fig. 4

ARRANGEMENT FOR CHANGE GEARS.

U is seen at *Y* and *Z* in Fig. 4. The gear combinations and pitch of lead screw are not shown, and can be decided by the one making or using the machine.

One tool which was overlooked is shown in the supplementary sketch, Fig. 5a. This is a holder in two parts for filing, and stoning for sharpening the thread tools. The two halves are screwed together, being hardened and lapped on the

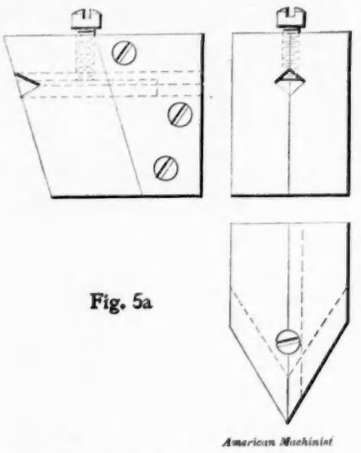


Fig. 5a

A THREAD TOOL LAPPING FIXTURE.

Figs. 6, 7 and 8 illustrate a little tool that I made for myself for fluting taps, which I find more convenient for taps of ¼-inch shank and under than the milling machine head. I use it in the milling machine vise as shown, using a Brown & Sharpe cutter reversed, dropping for the cut and running out as seen by the arrow and dotted line *i*. The tap shank *d* has a collar on the end held with set-screw *g*. The collar has four index holes for pin *h*. A set-screw *h'* further secures *d*, and a piece *e* prevents the work pulling forward. The adjustable V-rest *f* is easily put in place. The block *b* held in the vise *a* is not moved in cutting different taps. The tool is all right for small work in a large machine. Cutter easily set, good light, taps changed quickly, and the index collar remaining on the tap or reamer, etc., they are easily replaced for cutting deeper if required.

Figs. 9 and 10 are two styles of spring tools used for cutting smooth threads on soft steel, and they obviate the thread-tearing evil to a great extent.

I have cut a very smooth thread with the same tool that roughed up the work on one end of the same piece of steel by

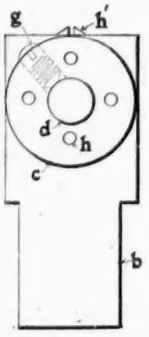


Fig. 8

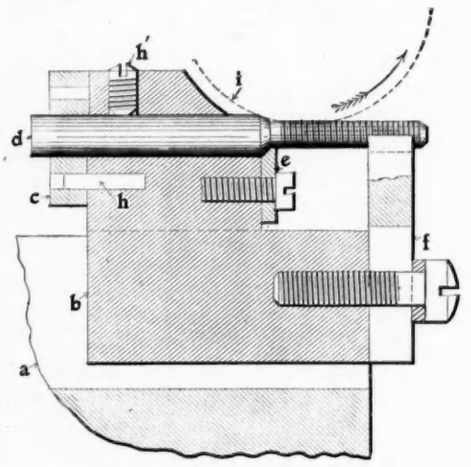


Fig. 6

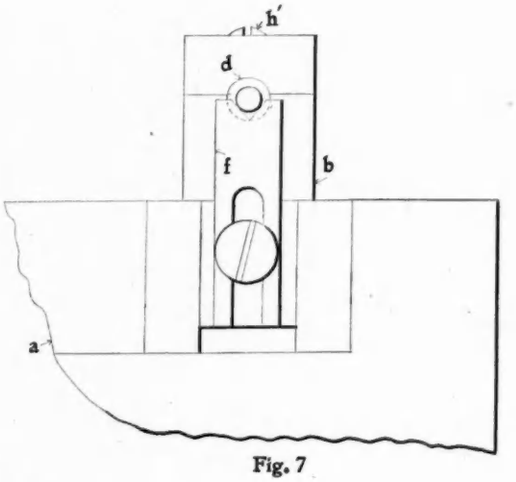


Fig. 7

TAP GROOVING FIXTURE FOR SMALL TAPS.

Fig. 5. The stud *T*, Fig. 2, when cutting, runs along the face of *K*. When it reaches *O*, Fig. 1, it slides up the angle at the end of the latter, lifting the thread-tool out of the work. When the stud rides upon *O* the thin slip *N* lifted by the spring *P* goes up between *T* and *K*.

When the lathe is reversed, *T* sliding back on *N* keeps the tool out of the work, but at the same time forces *N* down by climbing the incline on *M*. When *T* reaches the top of this incline of *M* it is snapped back over *N* by the flat spring *J*, which constantly holds *B* to the work or the parts *O*, *K*, *N*.

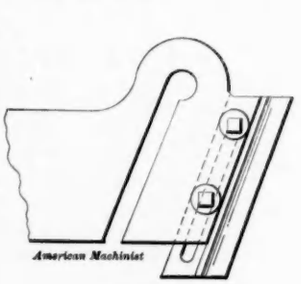


Fig. 9

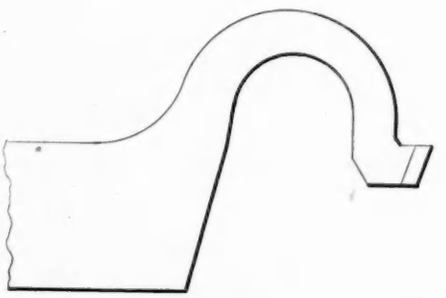


Fig. 10

THREADING TOOLS.

Fig. 3 contains *W*, a lock-nut for clamping in conjunction with the collar *V* the intermediate stud-bar *U*. The second intermediate stud-bar *X* is shown in the same figure. A front view of the stud on faces of the 60-degree angle, which makes a jig for the above purpose. The hole for the square corresponds with the one in the lathe tool-post, so the cutter is put in position for work easily.

heating the steel and hardening it on the other end and letting the temper run out, and then cutting a thread on that end. Heating and water-annealing or chilling in the air so as to leave the steel slightly

hard, will answer. But it is best to cut the thread near to size before finishing in this way. Watch pivots turned with a graver or hand-tool are worked just below a spring temper.

Fig. 11 will answer for two descriptions: First, the piece *b* is a fork for pushing work similar to worm-screw *c* on and off an arbor. The lathe spindle *a* is supposed to have a lever movement. The collar *e* is fast to *a*, and *b* swings in *e*, and is dropped down in front of or behind the work for pushing or pulling as required, and is thrown back out of the way after use. The arbor *d* is slightly tapering.

I saw a lot of worm screws like *c* recently, made of brass, which were about 3-16 inch in diameter, and were being threaded in a small bench screw-cutting lathe.

The work was going badly, as the tool, after taking up end-motion in the slide-rest, etc., would always climb on the last thread in particular and make uneven

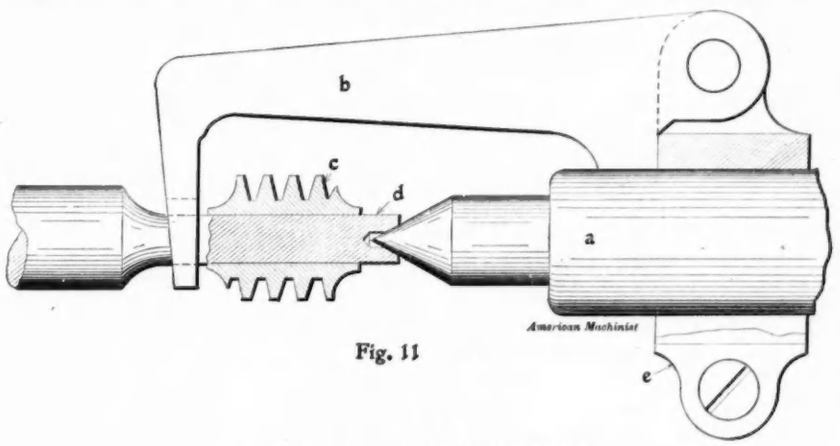


Fig. 11

FIXTURE FOR CHASING SMALL WORMS.

work. This was completely remedied by giving undercut to the back of the thread-tool and making the front of the same crowd. The tool cut more freely behind than in front. A fancy job can be made on brass by following with a hand chasing tool, highly polished. Have the chaser as wide as the worm-screw where it is a short one, say ⅜ inch. Where the stock is hard it is well to have the thread-tool tip, so as to conform to the pitch of the thread.

The spring-tool backs away from the work, instead of digging in or permitting the work to craw on to it, as when the point of a rigid tool is above the center of the work. In the latter case the radius of the tool-point swinging from the post reaches forward as it springs down and digs in. Worm-screws like *c*, Fig. 11, made of drill rod or stubbs steel wire well annealed, and cut in a Fox lathe with a single-point tool, can be handled wonderfully. With the worm about 5-32 inch diameter and threads cut fine and deep, I have known a man to cut from 15 to 20 an hour, and use one tool for from 300 to 500 screws without sharpening. He had a nice depthing adjustment and took fine cuts, but made them fast.

Brooklyn, N. Y.

Education of Machinists, Foremen and Mechanical Engineers—II.*

BY M. P. HIGGINS.

A SCHOOL SHOP CANNOT BE TOO PRACTICAL.

It has heretofore been feared that a technical school might become a shop with a school attached. This gives rise to the danger of a shop becoming weak and impractical.

There is a strong argument for school shops which shall be much more intensely practical than any which have ever been established or advocated. School shops should be object lessons, in every sense, as to the conduct of a first-class manufacturing establishment. They should, to an extent as complete as possible, illustrate good and economical shop methods such as must inevitably lead to a successful business.

It would be a very narrow claim for the school shop to say that its only desire is to teach the names of the various machine tools and their uses, how things are operated, how a chip may be taken off, and have nothing further to do with preparing a young man to organize a machine business, and produce machinery which in quality and design would take the lead in the markets of the world, and produced by such advanced methods and economical management that no competitor in the world can take the market away from him.

The ability of our graduates of engineering colleges to be able to talk intelligently about machinery, and to run the machine, or even to be able to produce a very fine and exact piece of work regardless of time or best method, will not give success. They must build the best machinery at less cost than others.

The importance of securing wise, economical shop management, particularly of the kind which manufacturers look in vain for foremen to possess, has already been emphasized in the introduction to this paper, and the lack of any systematic, practical training in such an important element as economy in a successful mechanic has already been referred to.

COSTS.

It seems to me that this important kind of experience just referred to can best be obtained in a school shop. It is too expensive when obtained in business life, and is the most costly subject of any to the manager. I would give a distinctive place to a Department of Costs in the proposed school, and emphasize the importance of it.

I have thought that such a department may be subsidized by external aid, so that the expense of the investigation, determination and comparison of costs need not be chargeable to the general expense account of the school shop, but might be borne by manufacturers, to whom reports on such a subject would be of great value.

Other departments in connection with the school shop, which it is not necessary now to consider in detail, I would have conducted along equally practical lines.

PROPER STANDARDS FOR SCHOOL SHOPS.

It is of great importance that a high standard be at once established and maintained. There is commonly considerable danger of attempting to accommodate the shop standard and requirements to the inexperiences of the pupil. It is, however, never necessary to lower the standard because the work is to be done by boys. It is surprising how students will readily approach a high standard. Indeed it is less difficult to bring students than journeymen to comprehend and maintain a high shop standard.

The great difference between the two is not so much in the quality of the work as in the quantity, and this difference is very great indeed. This unexpected element in students comes out very clearly in the matter of injury to tools and spoiling work. It is my opinion that during the twenty-eight years of experience at the Worcester Polytechnic, notwithstanding the very large number of students, there was hardly a larger amount of work spoiled or more injury done to the tools than would have resulted if the large number of students had been replaced by average journeymen machinists.

IMPORTANCE OF A PROPERLY ARRANGED HOUR-PLAN.

This subject is of greater importance in a school where shop practice is part of the course than in any other course of study, because it is so necessary that the periods in the shop should be as long as possible without danger of over-wearying the student. Therefore, it is very desirable that no period of shop practice be less than a half day, and also that an afternoon period of practice be always followed by a like period by the same class the following

*Abstract of a paper presented at the New York meeting of the American Society of Mechanical Engineers.

forenoon. For example: a student would begin his weekly shop practice Monday afternoon at 1 o'clock; he would leave his working clothes near his work, on the lathe, for a free evening and a night's rest, without any anxiety about lessons, returning the next morning to take up his shop work where he left it, and continuing the same throughout the forenoon.

By this method the great advantage is secured of having, so far as the shop work is concerned nothing shorter than a whole day's session, and, so far as the student is concerned, two half-day sessions, with an evening of recreation and a night's rest between.

A similar advantage of such an hour-plan obtains in regard to the work in the schoolroom.

HOW MUCH CAN BE ACCOMPLISHED FOR STUDENTS IN THE HALF-TIME SCHOOL IN A FOUR YEARS' COURSE?

First—We can confidently assure a more thorough expert knowledge of the machinist's trade, and a more practical skill in its various departments, than is generally secured by any apprenticeship in this country or Europe. This rather large expectation is based upon quite a thorough personal study of what is accomplished in England, France, Switzerland and Germany, and also upon what has been accomplished during twenty-eight years at the Washburn shops of the Polytechnic Institute of Worcester, Mass.

In this school, where a three and a half years' course included only 2,376 hours of shop practice, or, in other words, less than one-third of a three years' apprenticeship, the graduates have always enjoyed a high reputation for practical skill and shop experience. And it has been claimed throughout the history of the school that its graduates are as skilful and effective practical machinists as those who have served a three years' apprenticeship to learn the machinist's trade. This is a very bold claim, when it is remembered that together with this attainment of practical skill the graduate has obtained a thorough technical and scientific education. After a very thorough experience and after employing large numbers of these graduates in all capacities in machine shops, I think the claim is well sustained.

In the half-time school actual shop practice in the various departments would cover a much longer time, and under circumstances more favorable, because the attainment of a thorough machinist's trade is confessedly the central point from which the future engineering work is to emanate.

Second—These pupils will receive, as a part of their shop practice, a much larger amount of time in lectures and instruction upon the technical part of the machinist's business than is given in the technical school.

Third—It is proposed to train every pupil in the general knowledge and practice of drawing and machine design, and anyone having particular taste in this direction can have special and advanced instruction, the object being to make draftsmen superior to engineering-school graduates in the following particulars:

(*a*) More expert in execution of drawing and lettering.

(*b*) Much more thoroughly familiar with all the shop knowedge affecting the efficiency of a draftsman on simple every-day work.

(*c*) A more ready, reliable and precise use of arithmetic.

Fourth—It is proposed to train every pupil in a general knowledge and practice of pattern making and foundry molding, and in special cases give advanced instruction and practice in pattern making. In all cases, however, the machinist's trade will be taught as the basis of any special line of mechanical work.

Fifth—Pupils who exhibit suitable qualifications as workmen and as directors of men, will have special opportunities to become fitted for responsible positions, as working machine-shop foremen. Such pupils, among other qualifications necessary for foremen, would be required to show general ability in drawing, pattern making and special accuracy and reliability in arithmetic.

Sixth—If anyone from the above mentioned classes of men exhibits taste and natural abilities for high-grade engineering work, requiring the highest mathematical and scientific knowledge, he will be encouraged and aided to take a course to meet his special requirements in an engineering school.

To consider the third of the prominent features already briefly stated, viz.: "Instruction in the public schools during a portion of the other half of the time, equivalent to a high-school course, restricted, abridged and improved to meet the needs of these pupils."

WHAT ARE THE DUTIES AND RESPONSIBILITIES TO BE ASSUMED BY THE SCHOOL BOARD?

The School Board of any town where it is proposed to establish one of these half-time schools must be induced to make what seems to be a most reasonable provision for a class of boys whose needs are as imperative and as reasonable as those of boys who wish to fit for college. Therefore the present high-school course for this class should be changed and made especially suited to their needs. This is as reasonable a demand, if not more so, as the demand of the boy to be fitted for college.

The necessary provisions on the part of the public school consist in room and instruction for a certain number of boys. Only one-half of this number will be in the school-room at the same time. On the score of economy this arrangement will be greatly in favor of the half-time school over the present method.

I have not thought it wise to burden this paper with the details of the course of study; suffice it to say, that I believe it possible to cover in the four years' course all the studies which a liberally educated mechanic will require, and at the same time to prepare him nearly or altogether to enter a technical school, if his ability and opportunity permit.

As to the fourth of the prominent features of the proposed school, viz.: "Special care and method of selection of pupils who have finished the grammar-school course, and who have special aptness for mechanical work," let us consider

THE IMPORTANCE OF GOOD MATERIAL AND THE SELECTION OF STUDENTS.

Do we get the best stock for engineers? We have the sons of engineers who stand first in the great industrial enterprises. The young men coming to the engineering schools are generally the best in many ways. They are usually well born; they do not often come from poor homes, where work, stern effort and self-denial keep boys out of reach of the thorough systematic mental training which fits them for entrance examinations. If such a boy from the poor home finds it possible to enter, the college life is rather out of his line and out of his reach, and the funds for the term bills are still more impossible. But in this class are many who should be fitted for the different grades of mechanics.

It is well to remember, in the light of all history, that the revolutions of fate bring the submerged to the top, and after a while the child of fortune becomes enervated by advantageous ease and good keeping, and frequently the son, in spite of the father's determination to give him a better chance than he had, lacks something which has distinguished the father, and we may, after all, search this class in vain for the best stuff for engineers. It cannot, however, be the wisest educational scheme which allows the rich man's boy to degenerate, or merit to go undiscovered in the poorer classes, wherever it may exist.

There are marvellous possibilities of skill and invention among a class of boys who are never thought of as possible engineers, boys who sometimes make themselves leaders among the favored ones of the earth. In one of the largest and most prosperous industries nearby I find that the man who knows the most about a very important department carried a hod when the factory was building ten years ago; and the responsible head of another department was snagging castings eight years ago. One of the fond hopes of the half-time school is that it will pan out the pure metal by a sifting process which is true and fair; and selection of material is the first important step in the process. The selection of the pupils is only second in importance to the schooling itself.

The proper education of the American mechanic will not necessarily be sought after by the boy who is best capable to become the mechanic. He must be sought out and then trained. The American boy needs to be awakened to the inducements

for becoming an educated mechanic. Many a boy who is splendidly suited by nature and by inheritance to this calling is allowed by outside influences to drift into some other calling to which he is not adapted, all for the lack of a little guidance or some circumstance having no connection with his fitness or aptitude for mechanics, and thus is lost to the profession which needs him.

The hindrance to the best results in engineering schools, which has come from the imperfect and unfair method of selection in making up or enlisting its classes, has already been mentioned. Under the present system it is a boy's business to spend several years of cramming for examinations after he decides upon going to a polytechnic school or college. His whole aim and the aim of his teacher is to prepare for the examinations. The fitting school develops an astonishing ability to pass examinations which are not a true or adequate test of a boy's fitness to make a mechanic or a mechanical engineer. Therefore the entering class of the polytechnic institute consists of a body of experts at examinations, while the boys all through the country who ought to be trained for manufacturing and mechanical industry are overlooked and passed by.

It is proposed to avoid the bad defects due to this system in the half-time school by providing

A SUBSTITUTE FOR ENTRANCE EXAMINATIONS, OR AT LEAST A SUPPLEMENT TO THEM.

An appointment to the half-time school would be the result of careful, honest, quiet investigation into the boy's life, as to his habits of work and study, as to his personal habits of order, as to how he spends his evenings, Sundays and holidays, as to his love and care of tools, and as to his tastes for mechanical work, especially as to what he has actually constructed with tools before he is fourteen years of age. All these facts can be collected from his neighbors and teachers, and so verified that more reliance may be placed on them than on any common entrance examination. Are not these things a truer indication of a boy's fitness for the life of a mechanic or engineer than the one single quality of being able to pass written examinations in recitations, such as the colleges require for entrance?

THE ADVANTAGES OF A CORPORATION FOR THE MANAGEMENT OF SCHOOL SHOPS.

Perhaps the most successful technical schools have been organized by private corporations and managed by a board of trustees who have had all departments, scientific, practical and literary, under their direction. It is believed that the plan proposed for the half-time school, where a corporation is formed and a charter secured for doing exactly what the school-shop wishes to do, will have great advantages over educational corporations as heretofore formed and chartered.

It is difficult at present, though not so difficult as it was twenty-five years ago, to find available men who are competent to assume the direction of both school and shop; and when this responsibility is divided and assigned to different men, the difficulties do not disappear.

A corporation chartered to conduct school-shops independently of the book department of the school need not be limited, as our technical school corporations are. That is, they would be chartered to conduct a school-shop solely for educational purposes by means of a commercial shop which would sell its products in the open market for the benefit of an educational institution.

One of the greatest objections to commercial productive shops in technical schools, and possibly the only real objection, has come from the complaint of local manufacturers, who make the narrow claim that an educational institution exempt from taxation, has no right to enter into competition with other manufacturers who are obliged to pay taxes, and also obliged to pay all their help, while the students work without pay in school-shops.

Of course this argument is not reasonable, since any manufacturer is at liberty to take students if he can offer them instruction and wages valuable and attractive enough to compensate them for their time. Nevertheless, this objection has had an influence and has been a hindrance to several of the most promising technical schools.

The trustees of the half-time school shop would be business men chosen for their ability and practical knowledge in all manufacturing and mechanical industry, and especially for their interest in young men. These trustees would give their direct attention to the control, direction and approval of the acts of the superintendent in the conduct of the school-shops and the management of its financial and business affairs. The superintendent would be a competent man, appointed and subject to removal by this board of trustees. All other officers and employees of the shops would be under the control of the superintendent.

While the responsibility of this board of trustees would be primarily centered upon the shop department of the school, the book department, which is supported and conducted by the public school board, would be largely influenced by them, and they would quite likely be members of the school board as well as trustees of the corporation.

THE FINANCIAL QUESTION REGARDING THE CURRENT OPERATION OF SCHOOL-SHOPS AFTER THEY HAVE BEEN ESTABLISHED, EQUIPPED AND PROVIDED WITH A WORKING CAPITAL.

Having briefly outlined the scope of the shop-training for the pupils, it may be well to say a word regarding the business and financial aspect of school-shops. The chances for financial support and success are not less than with industrial enterprises where the central object and motive is to make money. The advantages respecting the financial success of the enterprise are:

First—The school-shops would have a superior board of trustees who would serve without pay.

Second—A property, equipment and some working capital without interest, and possibly free from taxation.

Third—The difficulties of establishing a reputation for reliability and excellent workmanship are no greater than in the case of ordinary shops.

Fourth—Business can be secured to some extent through the good will and interest of gentlemen having faith in an enterprise to aid young men and advance the standing of American mechanics and mechanical engineers.

Fifth—Although a large number of beginners in a shop bring great care and many perplexities, it must be insisted that fifty or a hundred young men, interested, earnest, well disposed, enthusiastic and energetic, bring a large amount of power, which may be indeed useful and valuable to the business when it is properly directed.

To carry out this plan there will be needed, besides a site:

For shop buildings	$20,000 to	$40,000
For equipment (machines and tools)	20,000 to	30,000
For material, raw, wrought, and in process, and accounts uncollected and cash for current business	40,000 to	60,000
Total	$80,000 to	$130,000

As a basis of confidence in the financial estimates for the maintenance of school-shops I have exhibited as an appendix to this paper [Appendix omitted—Ed.] a sheet of statistics covering a period of twenty-seven years while I was superintendent of the Washburn shops, a department of the Polytechnic Institute of Worcester, Mass., from May 1, 1869, to May 1, 1896.

This form of statement admits of ready comparison of facts from year to year, and for this reason it is believed to be more instructive than the usual form of report which was made by the superintendent annually, and from which this table is compiled. But for any reader who may not care to make a study of the table, I offer the following facts, which I take from the annual report of the trustees of the Institute at the end of the twenty-sixth year, namely:

For twenty-six years the average annual financial gain is $2,357.25. And the gain for the last five years is as follows:

1891	$4,567 80	1894	$ 7,326 88
1892	5,487 87	1895	15,729 90
1893	11,814 83		

Without including the income of this $50,000 fund, for the last five years the

shops were more than self-supporting, as follows:

1891	$1,660 70	1894	$ 4,430 49
1892	2,637 48	1895	13,063 85
1893	9,189 71		

This is after $4,500 have been set aside to cover possible losses in collecting.

It should not be overlooked that, notwithstanding this apparent overshadowing array of financial and business considerations, everything from first to last is made subservient to the interests and entirely for the best and highest educational advantages of the students, who are in these shops for what they can learn, and that their chances for becoming the most effective men are not to be hindered but enhanced by this atmosphere of real business. That the references for confirmation of my faith in the great possibilities of a real machine shop as the most effective means of education and of my faith in its feasibility wherever it is given a fair chance may not seem too local and too personal, I do not wish to confine your observation to the Worcester school, where a kind Providence decreed the better part of my life should be spent. But we have established similar school shops nearly equal in extent and importance in Virginia and in Georgia. In Atlanta, Ga., where I spent a year in assisting to establish the school-shop, the result, educationally, was everything that could be desired and more than was expected.

At the Miller School, Crozet, Va., where they have extensive shops and excellent equipment, situated in the midst of a country in great need of machinists and other mechanics, the school is so richly endowed and funds are so plentiful that there has not as yet been much done beyond a high class of manual training. If this school would employ forty good, skilled mechanics, and, with the abundance of iron, coal and timber near at hand, manufacture $100,000 worth of school furniture, agricultural implements and first-class machinists' tools each year, under the eye and with the help of one hundred students, who can estimate the effect upon the manufacturing and mechanical industry of that grand old State?

Besides the chief features of the proposed half-time school I would also refer to others of, perhaps, less importance, yet of value in such a scheme.

VACATIONS.

There is a great opportunity for improvement in the education of the boy offered by a radical change in the matter of vacations. The present method is to crowd the work of the week into five days, and the work of the year into thirty-five or thirty-seven weeks, making it as intense as possible for awhile and then letting up entirely.

It is certainly not impossible to arrange a course of education and training of a boy with hard work so judiciously distributed and so interspersed with healthful, easy and enjoyable exercises, and so intermingled with daily (not quarterly or yearly) recreation, that he will never need or require entire or complete relief from duty. Nothing is so dangerous or so trying to a boy's nervous, mental and physical constitution as the method of suddenly applied load and long intervals of total relief. Six days' work in a week, with sufficient variety, recreation and healthful exercise distributed throughout each day, and with Sunday properly spent, will, I think, assure much better and more enjoyable effort on each following Monday than is possible where all the students' work is dropped for two days every week.

The same gain may be obtained by distributing the work throughout the eleven or twelve months of the year. I must not be understood as recommending harder or more work. I would make an easier course for boys, not a harder one, by having a better arrangement and distribution of an ample amount of daily work, rest and recreation, and then instead of the present vacation, which is frequently harmful instead of helpful, I would grant furloughs to any student who needed or desired it. Such furloughs are not impossible or impracticable and would be, in my judgment, much better and more effective than the present vacation seasons. Let it be understood that this presupposes a school organized for the good of the pupils and not for the convenience of the teachers.

IS THERE A DANGER OF MAKING THE SCHOOL COURSE TOO SEVERE?

It seems to me that this danger is very great, a danger that has already been realized, from time to time, in almost every institution of learning. Many methods have been resorted to, to avert the danger, such as shortening terms of study, which necessarily make them more condensed, the introduction of athletics, etc., which is apt to absorb enthusiasm needed for the work; and when I have suggested continuous school work, less vacations and less interruptions, I insist that I do not believe in harder work but easier work for students, and I believe that a four years' course can be so arranged, with such interesting and profitable variety of occupation alternating between the recitation room, the drafting room, the pattern-making room, the machine shop, the shop lecture room, and with the requisite amount of exercise and recreation, not at long intervals, but in every half-day, that a boy's life from fifteen to nineteen would be a joy and not a burden.

DEVELOPMENT OF CULTURE IN THE SHOPS POSSIBLE.

Although, of course, we want better educated workmen, it does not follow that they need nothing but more years in school before they go into the shops. We have complaints on every hand that workmen are dull, coarse and uncultivated, as well as ignorant; and there seems to be a general belief that education would remedy many of the existing evils among workmen—evils which spring up from the selfishness, jealousy and narrowness which lead to all the bad effects of some forms of trades-unionism. But education, if it is confined to the bookwork of the class-room, consisting largely of learning facts, will not in itself remedy these evils any more than the mere acquirement of skill. This is only a part of the education needed by machinists, foremen or engineers. The fact that men of culture are commonly university men has naturally led to a wrong conclusion as to the effect of education and to erroneous expectations regarding the remedial effects of universal education for the evils of the working classes.

The scholastic work of the university is indeed but a small part of the good of the college life. Commonly the boy who enters college has inherited the elements of culture, and he leaves a home where all the early and formative portion of his life has been amid influences of refinement. Whatever additional culture he attains comes very largely from his social intercourse with superior men as instructors and from college life with his mates, who are, in most cases, his equals or superiors. We are likely to ascribe altogether too much credit to the learning acquired at college in the development of the man. I do not say this to disparage in the least the superior culture of the educated man. But a clear knowledge of the true source of this superiority is of vital importance in the consideration of my subject, especially the education of machinists. Book knowledge, however important and valuable it may be, is but a small part of the general education needed by the machinist and the foreman. From this fact, to a large extent, springs the confidence in the plan of technical education which this paper proposes. It proceeds upon the assumption that machinists need education and culture, and can make good use of them, and that it is possible to supply these within much less time than is usually devoted to scholastic work in the case of boys who are born in more favored circles and are educated for the professions. Wonderful results can be obtained under favorable conditions in developing culture and the higher traits of character and mental discipline in the workshop, and possibly as effectively as in the school-room. It has never been proved that this is not entirely practicable. I am convinced of its soundness, and I think that its reasonableness is very evident. We cannot say that because culture has commonly been developed to the highest degree in scholars who have devoted themselves to the study of the dead languages and ancient history, etc., that it follows that they would not have become equally cultured had they devoted as much time and talent to the study of other and more practical subjects. There is good reason to believe that faithful devotion to the

study of mechanics, mechanism, machine design and similar work, leading to and including mechanical engineering, may prove to be the best possible lines of study for development of the highest and best mental qualities of man. Certainly no other line of human activity can so directly cultivate the creative powers of the human mind and develop the imagination. We hear of the artist's love of beauty. The mechanic may find beauty in a thousand places all through his work. He can be a designer and a sculptor in his own art. The scholar has a passion for truth. There is truth demanded and found everywhere in the realm of mechanics, and to find it and to be able to secure it is one object of the education of the mechanic. It is not denied that one source of culture comes through the acquirement of knowledge and skill, but this is only one means, and perhaps not the most important one. A more important source, as already mentioned, is by the intercourse with superior men and teachers, and this means of culture is just as possible in a machine shop as it is in a college, provided we can secure the superior men for teachers in the shops. In the past, conditions have been so unfavorable for the education of mechanics that it is difficult to appreciate at first thought the large possibilties of their future development in this direction.

HOW SHALL WE SUCCESSFULLY MEET OUR FOREIGN COMPETITORS?

America has made a strong beginning as an export nation of high-grade machinery. There are many evidences of the keen interest, amounting to surprise and alarm, on the part of our European rivals. It is interesting to note their efforts to discover the causes of this sudden uprising of a new and evidently powerful rival in a field heretofore all their own.

The cause of our supremacy has not been altogether the superiority of our engineers, for they also have highly educated engineers. But it has largely resulted from the superior character and make-up of our mechanics, which has come from the chance which America gives the workman, and in the liberal and wise provisions to train free-born American boys, giving each a fair field and open path to rise from one plane to a higher one as his abilities and circumstances may warrant.

We must not allow ourselves to rest secure in the belief that our Old World competitors will be slow to discern this cause or slow to profit by the example. Therefore, what more potent steps can we take for our protection than to keep this path open from the bottom and to better our methods all the way up through the successive steps?

The index for 1899 will be inclosed with next week's paper to all mail subscribers. Anyone else who desires a copy may obtain it by sending postal-card request to this office.

Letters from Practical Men

Gas Engine Governing and Economy.

Editor American Machinist:

The gas engine is governed by two distinct methods. One of these is known as the hit-and-miss method and the other as the method of regulated charges. Speaking generally, it may be said that the former method has so far been more common in Europe than the latter method, and I believe I am correct in saying that the latter method has been chiefly adopted by American makers. Each method has its peculiar advantages and disadvantages, which it may not be out of the way to discuss; but it is a little curious to note that probably both systems owe their being to the dearness of coal gas, as I hope to show, though this factor has brought about such opposite conditions of operating along two distinct lines. The first gas engine I ever saw was the vertical free-piston type, in which an uncompressed mixture of gas and air was exploded in a vertical cylinder, which was shot up in this tall cylinder against the atmosphere and only engaged with the crank shaft on the down stroke by means of a pawl gear, the down stroke being performed by atmospheric pressure above the piston and a partial vacuum below the piston due to condensation of the gaseous products by the water jacket. Obviously, such an engine could only work to any serious power with a gas consisting largely of hydrogen, which would form water on exploding and greatly improve the vacuum on condensation; though, of course, the ordinary cooling of the heated gas would do much towards producing a partial vacuum. In these early days there were a host of non-compression gas engines put on the market, many of them very ingenious in design. There was the Bischop, for example, in which the crank shaft was a little to one side of the cylinder center, thereby permitting a very rapid upstroke of the piston and a more direct pull on the down stroke. Large numbers of these different engines were sold, and worked well; but they were necessarily wasteful of gas, and after the introduction of the compression principle they melted away and disappeared altogether. All the early gas engines were used by men who had no special need for uniform turning velocity. They drove pumps and chopped hay, and did work for men who had not work enough to employ a boiler attendant, and they were economical not because they burned so little fuel, but because they required no extra attendant, and because for many hours they burned nothing, being at rest.

In this way it came about that, burning as they did a costly fuel—illuminating purified coal gas—the question of fuel economy was much more important than that of regular turning. So very important, indeed, was this factor of fuel expense that for many years gas engines made very little way indeed in America, because coal gas was double and treble what it was in England, where it varies from about 44 to 72 cents per 1,000 cubic feet. Gas engines were well established in England before much had been done anywhere in the way of electric lighting or power; but in America electric power put a stop on gas-engine power, because electricity in America can be as cheaply produced as it can in England, and is therefore better able to compete with more costly gas.

The hit-and-miss method of governing which is so common here consists, I need hardly explain, of a swinging knife-edge which is held higher or lower by the governor, and only swings into contact with the gas valve when the speed of the engine drops below a given fixed rate. So governed, an engine must fluctuate between certain limits of speed, and this limit, or rather the range of fluctuation, is kept narrow by the use of heavy flywheels, and has tended to rapid rotation of gas engines. With the use of illuminating gas this hit-and-miss method has maintained its hold owing to its superior economy, and is still used even on engines which employ producer gas. It is only since the gas producer has begun to make way in America that gas engines have also progressed. Producer gas is so cheap that it has enabled gas engines to be more employed, and the cost of power thus produced has been found so small that the advantage of the hit-and-miss method of governing has lost its chief point of advantage for the money cost of the more regular control by regulated charges is so very small as to afford the advantages of regular rotation. Thus we see that the expense of coal gas has not prevented the employment of gas engines in this country, but has demanded that they be worked on an economical basis, and that in America it has put back the gas engine until the present time, when producer gas, being an acknowledged success, has allowed the demand for gas engines to be filled easily, and the gas is so cheap that a little can be wasted for the sake of the steadier rotation. The same system of governing by regulated charges has of course long been known here, but not much employed; but the same cause which is acting in America is also acting here to further the method, and I have myself advised the regulation method for engines using blast-furnace gas, which is so cheap and plentiful that if anyone undertakes to use the output of a single furnace, he will need to put down about the biggest installation of gas engines yet going. It is surprising to see how very slowly people wake up to the idea of using the waste gas of the blast furnace. In California they will spend thousands of dollars in building headworks, dams, tunnels and pipe lines to utilize distant water-powers, whereas the

cost of utilizing waste gas is very much less. It is almost as though everything in a water-power scheme were to be given free except the turbines. I think that there can be very little doubt that in a few years we shall see a large amount of electricity generated by gas-power from gases now practically wasted. Why more is not being already accomplished I will endeavor to show in another letter.

W. H. Booth.

London, England.

A Machinery Sale.

Editor American Machinist:

I was present at a sale of machine tools the other day, and as it will indicate the condition of the machinery market to some of your readers better than your "Commercial Review," I will tell them about it.

The sale was to begin at 10 A. M., and at that hour the superintendent and myself arrived at the place indicated by the circular, and after inspecting the tools as best we could through the windows and keyhole, the engineer was bulldozed into letting us into the factory.

We waited until 11.15 (during which time a large number of would-be buyers had come in and looked over the stock), when the dealer, who, by the way, is a well-known advertiser in these columns, came in. Before he could lay off his coat he was buttonholed by one of the customers present, and in less than one minute the word "sold" was chalked on a large planer near the door.

We at once interviewed the gentleman as to the price of a B. & S. No. 1 milling machine that had been in use some fifteen years or less.

"Four hundred dollars, taken as it stands, as it is sold at that price if I deliver it in New York," was the reply.

A 16-inch Prentice lathe and a B. & S. tool grinder were selected as being what we wanted, and the prices, $200 for the lathe and $135 for the grinder, were swallowed with a gulp, and right of refusal for a day was requested.

"Not one hour, gentlemen!" was the firm, though courteous, reply. "The fact is this, gentlemen: Every tool in this room is sold just as soon as I can set it down in New York, and I cannot grant the favor."

The dealer was a gentleman, and the fact that he had two purchasers for every tool in the room only added to the force of his reply, and the tools were taken without a murmur.

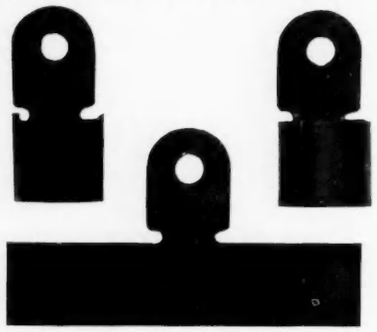
As we passed out of the building we saw the B. & S. miller being taken out, it having been sold at the price asked—though not to us.

I have sold lots of tools, but I never before had the pleasure (?) of seeing tools sell themselves. A. P. Press.

A Special Bending Die and its Work.

Editor American Machinist:

Of the different classes of dies in use for the press working of sheet metal probably there is none that taxes the skill and inventive powers of the mechanic more than those commonly known as bending dies. There are rarely two alike; the one you are working on usually differs in some respects from all previous designs; each punch and die is a law unto



itself, and after completion it is dismissed from one's mind, to be followed by something new. The peculiar or special feature of each job, however, is generally recorded in the note book of the up-to-date die maker for future reference.

The accompanying sketches show two punches and dies that we have recently made to bend a piece of flat copper 2⅛ inches long, ½ inch wide and .025 inch thick, into a circular form with an irregular contour and overlapping ends, the outside one being flared outward at the extremity. A sample blank and the two stages of the bending operation are shown in the half-tone, Fig. 1. On one side of the blank, almost in the middle, will be seen a projecting part, that, according to the specifications, must be flat and unaffected by the bending operations, and also central with the loop.

Following the regular experiments to ascertain the size and shape of blank required, the piercing and cutting die is made, and requires no description here.

Fig. 2 is a sectional and front view of the punch and die for performing the first bending operation, which comprises the bending of the ends up not unlike a letter U, with the highest end turned inward, the bend being 1-16 inch from the top. The blank is placed in the recess *A*, Fig. 2, which acts merely as a gage for locating it sideways; stops for the ends are ⅛-inch pins, not shown. The work is brought well forward to allow the projecting part to stand out over the front of the die to avoid bending when the other part passes down into the die. The downwardly-extending portion *B* of the punch is held stationary by the coil springs *C C* until it comes in contact with the bottom of the die. As the ram of the press continues on the downward stroke the notch in the shoulder at *D* strikes the end of the work on that side and forces it down to its proper hight, thus securing uniformity. At the same time the opposite end of the blank is passing into the slot *E* and bending inwardly. *F* is a dovetailed piece to facilitate the making of the slot *E* in the punch.

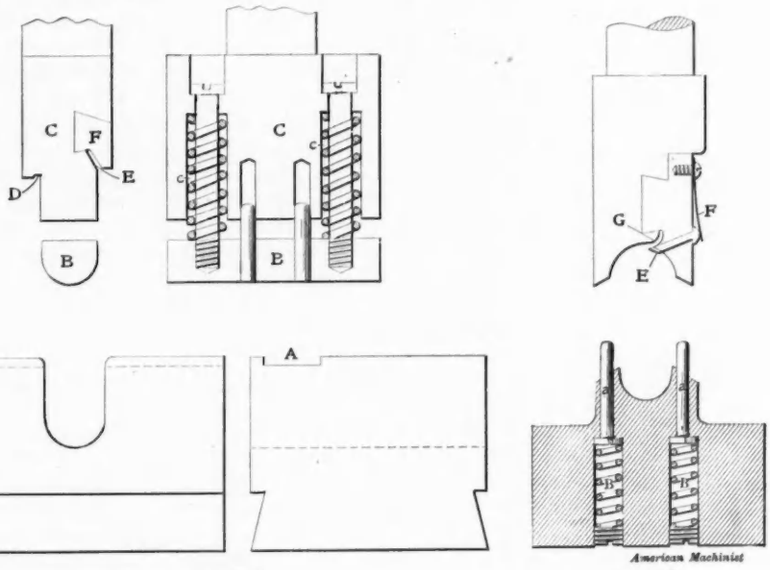


Fig. 2 Fig. 3

A SPECIAL BENDING DIE AND ITS WORK.

It is a good plan in this case to locate in the bottom of the die in rear of where the work comes a strip of sheet metal or a rigid pin, the same hight as the thickness of the stamping, to permit the punch to rest on. This will prevent a hard pressure on the work and allow it to slide around under the punch and avoid buckling when the shoulder at *D* presses on that side to correct the hight.

Fig. 3 shows the closing punch and die. Following the first bending operation, the

work is located on the die between the two pins *A A* that hold it in its proper position for closing. The pins are supported by slender coil springs *B B*, which are regulated by the headless screws below them. Screwed and doweled on to the middle front of the die is a small block of cast iron, not shown, with two pins, one on each side, to guide the pivoting part on the work during the closing of the circle. On the descending movement of the punch the pin *E* gives a slight pressure on the work, and causes the end, that has been previously bent in at its extremity for this purpose, to pass on the inside. The pin is retained in position by the flat spring *F*. As one end of the stamping goes down on the inside, the opposite one follows along the punch until it comes in contact with the upper surface of the pin *E*, when it is forced to pass up into the groove *G* and bend outwardly. The use of a round arbor is necessary in this operation to size the circle in the work.

DIE MAKER.

Lynn, Mass.

Welding.

Editor American Machinist:

Will some of the readers of the "American Machinist" please define the term "welding" as it is used in everyday practice? "Nothing easier," some machinist or blacksmith will say, and so the writer thought, when he was in the shop. According to some people, perhaps to most, welding is restricted to mean uniting two pieces of iron by hammering or pressure while they are at a "welding temperature," or, in other words, plastic enough to flow and intermingle with each other. If all people meant that when they spoke of welding, there would be no difficulty, but unfortunately they don't, and when you come to arrange a number of patents, for instance, as all being and belonging in the art of welding you are confronted with some other and different uses of the word. According to the definition of the term given above, there are only two metals which can be welded, namely, wrought iron and platinum. The reason for this is that these are the only two metals which pass through an extended plastic state in passing from the solid state to the liquid. But there are patents for welding steel, copper, aluminum, etc., as well as patents which call the union of a solid metal and a molten metal a weld, and even the union of two molten metals poured together or consecutively into a mold.

Whether all of these forms of union should rightly be classified under the head of "welding" is what the writer wishes to know. A good deal of difficulty is also experienced in drawing a line between those processes which should properly come under the head of welding, and those which should be classified under soldering, brazing, sweating, etc. If anyone can draw a hard and fast line between the arts of welding and soldering, the writer would like to know of it.

H. A. COOMBS.

Facing the Big Elbows.

Editor American Machinist:

If the writer of the article on "Facing Large Elbows," which appeared in your issue of November 16, intended to be unique in his method, every machinist will admit that he succeeded admirably. Still, a good many of us would kick if we had to lift the lot of ells over the tailstock, with the facilities usually found in the country shop, and then replace that bar and facing arm in the centers; and I've seen more convenient places to set up the dead center than the one shown.

I fail to see the object of using a tailstock or bar at all; or the planer platen either, for that matter. Seems to me the proper place for that facing arm would be to have it clamped to the large face-plate, the headstock raised on the lathe with ordinary blocks, and the ell clamped to the shears in position for facing. This would be fully as satisfactory as, though less elaborate than, the method shown. An improvement would consist of a guide-pin fitted to the hole in the spindle and projecting through the facing arm for several inches into the ell, and a spider, shown in Fig. 1, made of any old piece of cast iron, the hole *h* to fit the guide-pin, and the four bars made of 1-inch square iron, one end threaded to fit 1-inch tapped holes in the casting. When the elbow was in position, the bars could be adjusted to the inside of the elbow and screwed up tight. The facing of the elbow could then proceed, and there would be no chatter either, the only stress being a rotating one on either member. Fig. 2 shows the arrangement.

G. J. M.

Milwaukee.

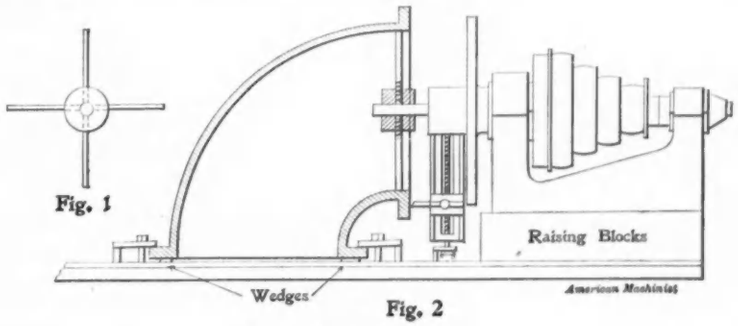


Fig. 1

Fig. 2

FACING THE BIG ELBOW.

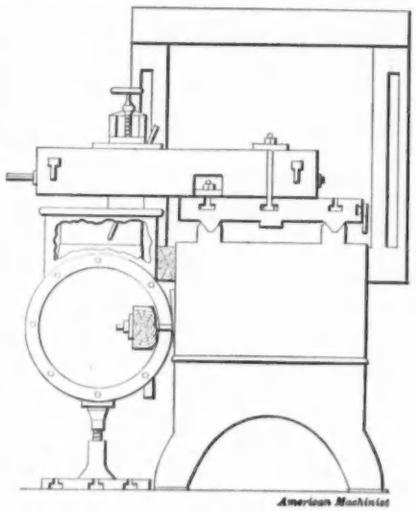
An Improvised Side Planer.

Editor American Machinist:

Having noticed through the "American Machinist" several ways of making a small planer do large work reminds me of a job I did once, which may be of value to other readers.

It being a frequent occurrence in our shops to replane valve seats on cylinders of different sizes, and having only a small planer to do it with, we often had to refit large ones by hand. This being a toilsome job, an idea struck me one day which overcame my labor.

The cut shows how inexpensively the planer was made to do this job. As we were in a hurry, and having but one at a time to plane, the feeding was done by hand. I do not pretend to say that the performance of this machine was perfect,



AN IMPROVISED SIDE PLANER.

but with a little hand work a first-class job was done.

I will add, also, that, to be better prepared for similar occasions, we had a rough platen cast and set in cement flush with the shop floor.

C. A. P.

Some Features of a Chicago Tool Room—Small Tools and Gages.

Editor American Machinist:

The shelves for holding small tools in most tool rooms, as I have seen them, are fixtures, so that if any set of tools was enlarged it would involve considerable tearing down and rebuilding, and the rearrangement of perhaps the entire shelf. The shelves of this Chicago tool room were something like Fig. 1, and the tools were placed, not on the shelves, but in trays which were set on the shelves, not fastened, at an angle of perhaps 45 degrees. Any of these trays could be removed and dusted, or cleaned, and re-

placed without drawing nails or screws or disturbing other trays. When the shelves were first built some extra length of shelving was made to allow for additional trays. If at any time a tray was

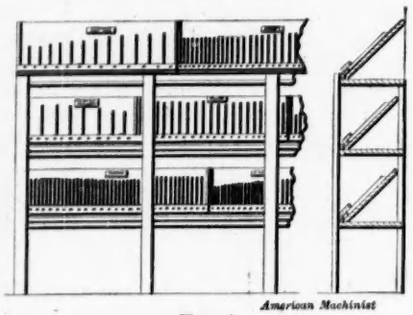


Fig. 1

SHELVES AND MOVABLE TRAYS FOR SMALL TOOLS.

enlarged to receive larger sizes of tools, it was only necessary to slide the other trays along a little to make room for it.

A tray for twist drills is partially shown in Fig. 2. There are in some cases as many as four drills of one size, among the sizes most commonly used. In this case the shank of each drill is numbered for the space in which it belongs, in addition to the figures for its size, and the space is similarly numbered. This prevents trading or mixing the drills. The same course is followed with hand taps, as shown in Fig. 3. The set of three taps is usually given out, and one date check and workman's check are hung on the middle hook for the set. For short and small tools, the strips forming the spaces being too close together to admit the finger, are made short, so that the upper end of the tool can be lifted with the finger. The case supplied by the maker with a set of hand screw-cutting dies and stocks was used as a tray, the hinged lid being re-

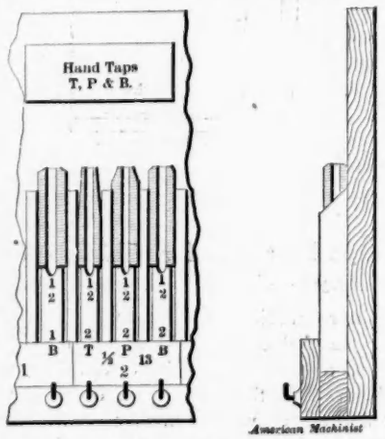


Fig. 2

TRAY FOR TAPS.

moved and a hole cut through the bottom from each die space, allowing the oil, which will drip in spite of most careful wiping, to drain into a tray of sawdust set on the shelf.

All of the special gages, jigs and templates used for duplicating work in this shop were kept in the fireproof vault, perhaps 12x20 feet and 18 feet high inside, opening from the tool room. A gallery about 24 inches wide and reached by a light stair made the upper portion of this vault accessible. Gas jets and incandescent lamps furnished light. The shaded incandescent lamps, which were ordinarily used, were hung with cords and pulleys and balance weights, and would remain stationary at any hight desired. The four walls from floor to gallery, and a low bench in the middle of the floor, were occupied by gages and jigs. The long flat bar gages, shown in Fig. 4, ranged to about 60 inches in length and were used for the bored and turned fits of a rock and ore crusher. The plug and ring gages were used for cylindrical parts of the same and other machines. Every one of these gages was marked like its place and

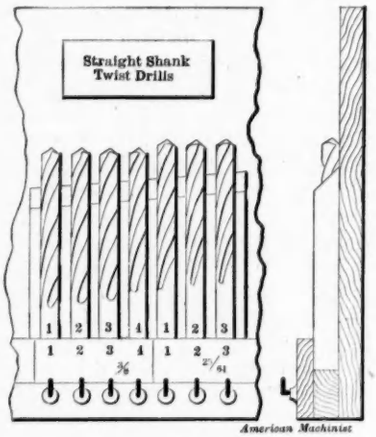


Fig. 3

TRAY FOR TWIST DRILLS.

checked out to the workmen in the same way as any other tool. After the introduction of the measuring machine, the sizes of these gages were marked in inches and thousandths on each gage. Then in case of accident to any gage it could be corrected. The wisdom of this course was demonstrated a few months later, when it was found that by some accident one of the gages for a turned taper fit had been spread, and several pieces of work had been turned to the enlarged size. If the original size of the gage had not been measured and recorded it would then have been difficult to tell which of the two gages, male or female, had been damaged. The correct sizes being marked on the gage, it was an easy matter to correct it with the measuring machine. If the two or three pieces of work mentioned had been shipped to customers without this correction, the total cost of correcting the mistake would probably have been greater than the entire cost of measuring and marking all the gages in the shop, and the effect on the firm's reputation for duplicate work would have been ruinous.

Among the other gages in this vault were male and female screw-thread gages ranging to about 15 inches diameter, a large range of plug and ring gages for taper fits, and a wide variety of drilling jigs with hardened bushings. The upper portion of the vault was pigeon-holed for storing a stock of drills, taps, reamers, files and other tools in common use, so that all sets in the tool-room trays could be kept full. In rearranging this vault for using the check system a number of gages were found with marks so nearly alike as to be hardly distinguishable, and some of the older gages were not marked clearly enough to give necessary information. Great pains were taken to mark all gages fully and distinctly, and in the case of old and seldom used gages to mark with a name showing the use of the gage clearly. In every case a label marked exactly like the gage or jig was placed just above the screw hook for holding the checks.

S. A. WORCESTER.

Springfield, Ohio.

Scaffolding Dogs.

Editor American Machinist:

Recently in the town of Meissen, Saxony (where all the so-called "Dresden" china is made), I saw a rig for holding scaffolding beams in place, which seemed to answer the purpose admirably. I will premise by saying that for a job of house-front painting, taking two days for two men, it is required to put up a complete scaffolding, the same as for building, covering the entire house front and taking five men two days to put up. To economize in timber, which is more of a factor here than labor, clamps are used and nails are almost entirely dispensed with. Besides the usual shaped clamps *E*, which are so plentifully driven into every place where there is a reasonable excuse for them—say, for instance, where a scantling is laid across a street on two horses;

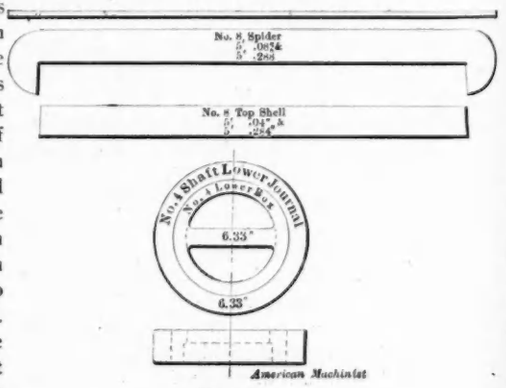
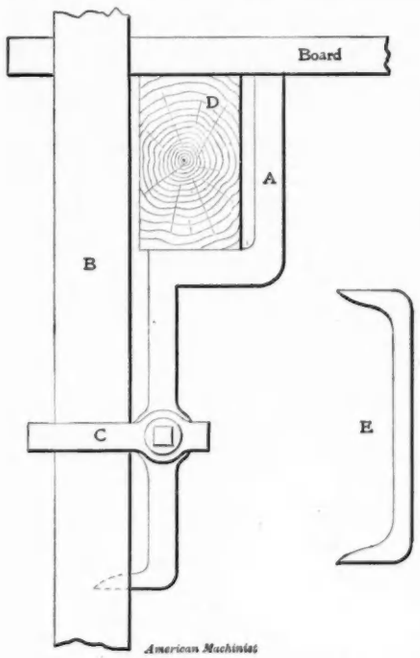


Fig. 4

SYSTEM FOR MAKING GAGES.

there it is dogged on to the supports to keep the wind from blowing it away, or thieves from running off with it—there were employed at Meissen clamps or dogs like the sketch, where *A* is one of two

similar pieces, the lower end of which is dogged into the upright *B*, and *C* a U-shaped piece which embraces the upright *B*, and through the legs of which, as well as through the two pieces *A*, a bolt passes. The beam *D* lies in the crotch or seat of



CLAMPS FOR SCAFFOLDING.

A. On it boards, or two-by-fours, are laid, according to the way the scaffolding is made up. Using these dogs, it takes much less time to put up, and especially to take down, the scaffolding than where spikes and nails are used; and the lumber is damaged much less, which here is a prime consideration. G.

American Exporters and South African Trade—Ultimate Effect of the War—Views of English Manufacturers.

Although the present effect of the war in South Africa is naturally disastrous to industry in that country, yet the ultimate benefit to trade will largely outweigh the temporary loss. I may fairly assume that the readers of this journal are fairly well acquainted with the grievances under which both British and American residents have suffered in South Africa; grievances directly affecting the export trade of the United States in that part of the world. To enter into that phase of the matter is unnecessary. The upshot of this war will mean an open market in South Africa for all nations, and a just and pure system of government. I have been making special inquiries as to the future trade with South Africa and find that most of the exporters in Britain frankly admit that the United States have a firm hold on that market, especially in agricultural implements, hardware of all descriptions, mining machinery, rails, locomotives, etc. Very many of the mining engineers engaged there are Americans, and they naturally favor the introduction of machinery with which they are quite familiar. In some instances I hear of American plants being placed in mines after the initial installation has worn out or become obsolete.

To give you an idea of the great expansion of the United States trade in this direction I may state that the value of American imports into Cape Colony during five years has risen from $2,000,000 to $14,000,000, and this in spite of all sorts of obstacles—raids, native squabbles and war. The following few statistics show the position clearly:

IMPORTS PER CENT. IN VALUE.

From	1894	1896	1897
England	78.59	66.07	69.80
Germany	3.96	6.12	4.83
United States ...	4.62	8.10	12.53

In all probability there will be a boom in the Rhodesian gold fields when matters settle down, and then will be the time to sell American mining plant out there. Up to the present England has supplied the bulk of that class of machinery. Your agricultural implements, carpenters' tools, bicycles, etc., are pretty well known out in Rhodesia.

There is a certain want in Rhodesia for Artesian wells and windmills, and the latter have very largely been supplied by American firms. At the time of the recent exhibition held in Grahamstown, the United States stood second in the import of cycles to South Africa. In arms and ammunition your makers are competing most successfully with Birmingham (England). Grape cutters of American make have become quite favorites, and large quantities are sold. Galvanized barbed wire is another article which is largely supplied by United States exporters. Special brands are in favor, as the "Iowa," quality satisfactory and prices usually lower than British quotations, the average cost being 20 per cent. less than the British rates. To show you what can be done I may add that an order for 40,000 tons for Cape Colony has been placed for American rails at, it is stated, 20 per cent. under English quotations. A large order for tubing has also been placed in the United States. As I understand it, it was refused by a Scotch firm, the American company complying with the customer's demand for longer lengths. The two orders aggregate $2,500,000. It is calculated that the approximate value of American imports into South Africa for the year 1898 will show an increase of $4,537,000 over 1897, or at the rate of 40 per cent., this notwithstanding the fact that the total imports into South Africa for 1898 were less than in 1897.

There will be plenty of orders to be had after the war. Several of the chief cities in Cape Colony are preparing to introduce the electric light, and will require plant for that purpose. Queenstown, in the same colony, has recently borrowed $25,000 for water supply works, and will be asking for tenders for the requisite machinery. Your pump makers ought to be alive to this chance, and, considering that pumps made on the American pattern (Worthingtons) are largely used in London (England) itself, why, there should be no difficulty in securing all the business in hydraulic machinery. Extensions of electric railroads in Cape Town and Port Elizabeth are under consideration, and it is useful to note that present plants are of American build. American machinery is employed in South African match factories, while your cold-storage plants are well known in Cape Colony, Natal, Pretoria and Johannesburg. I do not think the full value of the market for American household tools in the South African trade has yet been adequately realized. It is admitted by English dealers that the Americans have led the way in the production of stoves of this description. Your stoves possess advantages which are apparent even to the most casual observer. The castings are thin, and cooking is thereby facilitated; the ovens and top surface are commodious, the appearance of the stoves is tasteful, while the price is moderate. The British stoves made in similar lines lack the neatness of design so characteristic of the American production. It is estimated by dealers in the Barberton district (to take one locality as an example) that more than 50 per cent. of the stoves sold in that part of the country are of American manufacture. The business catalog of one of the largest importers shows that the leading American lines comprise chaff cutters, churns, corn shellers, plows and fittings, axes, lawn mowers, pumps, washing machines, all sorts of carpenters' tools, furnishing ironmongery and a general supply of hardware. I think that a good deal more might be done to promote the sale of American plows. What is wanted is an implement with steel mold, share, and wrought standard, with wood beam, in sizes from 9 to 12 inches width of cut. I hear, too, that an all-steel plow similar to the above-named pattern is likely to be in demand in the market.

The question is now being asked by English manufacturers, "Why is it that the whole of the trade in windmills for the use of the farmers in South Africa is in the hands of Americans?" In Cape Colony I do not think there is a single windmill pump of British manufacture. There is decidedly an enormous trade to be done in this line of goods. I have no doubt that some of our British exporters will try for a part of this business.

F. C. CHAPPELL.

A very full and valuable paper on nick l steel is among the recently printed proceedings of the American Institute of Mining Engineers, written by David H. Brown, of Cleveland, Ohio.

Legal Notes—Liability of Owners of Machinery for Injury to Employees.

In Turner vs. St. Claire Tunnel Company, 80 N. W. R., 720, a case recently decided by the Supreme Court of Michigan, the plaintiff was injured while working in a tunnel which the defendant was constructing under the St. Claire river. Compressed air was used by the company to prevent caving, access to the tunnel being had through the air lock, and the plaintiff claimed that the air lock was not properly managed.

The lower court rendered judgment in favor of the plaintiff, but the Appellate Court reversed the judgment and ordered a new trial. The injury complained of by plaintiff having been sustained on the Canadian side of the St. Claire river, the higher court based its opinion upon the question as to whether the defendant under the law of Canada discharged its duty towards its employees by appointing competent superintendents and workmen, and by authorizing them to procure all necessary machinery and appliances, or whether the company was the absolute insurer of the safety of its machinery and appliances and of the system adopted. In deciding the former question in the affirmative the court said:

"The use of compressed air for the purpose of construction is not attacked. It has been in use for similar purposes many years. The defendant, through its directors and president, had entrusted the entire work, including the purchase of machinery, to competent and experienced men. The directors, presumably, were not men of experience in these matters. They did as men must always do under the like circumstances. Having no practical experience or knowledge themselves, they did all that could be done if the work was to be performed at all, viz., they selected men of experience to perform it. It would be great negligence for inexperienced men to attempt to supervise such work and to determine what system and what machinery should be used. It has always been and always must be that those who build buildings, large and small, construct machinery, or engage in the construction of extensive work like the present, and are unskilled themselves in the strength of materials, the soundness of machinery, the proper method of construction, or the proper system of conducting the construction, of necessity must act through others and rely upon the judgment of others."

Troubles of an Impecunious Inventor.

The Canadian "Engineer" prints the following letter from a delinquent subscriber. It should in itself be good for at least one year's subscription:

"Dears Sirs I received yours of 27 Contents Noted. My silance in the Past has not bin frome Eny Desier on my Part to avoid Payment, or to Shurk My Respsnoobiley. the Matter in Question I had Hoped that Maters might git Better and, I Would be able to Pay you but as matters Was Worse each year I thought best to Stop your Paper forme coming longer in explaination of My Present financial condition. I Secured a Pattint on a Submerged Dredger (a World Beater) this was in 93 I of cors flirted with the goddis of Fortion that Presided over the destines of Patent Right Men, and Smile While they Build Air Castles. But Smash them With as little Remors as a Kansas Tornado Would dew. I listind to hir wewing for two years and when I Realized the truth of the Situation My finances, and financial Reputiton Was just in the fix of a Box Haus after the Kansas sicloun, Recognisable by Former Land Markes. I Will mention some of the Most Prominent land markes that exist to marke the Remains of What Wanst Was, namely a judgment for $6000 buy one Partey, a judgment for $800 but a nother Party, and $2,000 subject to judgment if the holder of the note cairs to take it, in all my missfortuns no one That Knos me acuses me of trying to Swindle them in further explanation I will state that I yet owe Borowed Money to some of my friends I cannot Pay other obligations untill I am able to Pay them something I ame to treat all my Credeter as just as, I can. I havent a sent in the Business, for when I waked up, I was not as, Ragged, as, Rip, Van-Winkle but was, as Poar, and did not have a god, to comfort me, in conclusion I Will say. I fully Recognise the justness Your Bill You Pubelacation's good and I appreciated them and have most all of them yet. You bill is recorded on the Tablets of my Memorie, and Will Paid When Reached in ther turn if Gabral dont tute hir Horn and say to, me Robbins With you time is, nomore, then the vail that hides the imortal form them that, Reman Will be drawn, then we will be remembored onley, with, those that are gon to that Born frome Whence no travler Return. We ar taught, in, the leson of Faith Hope and Charity that Faith ends at the grave, hope in Fuition but, Charity Endureth forever. We Hop that with Charity We may be judged. in conclusion I will say. I have for, 4, years, Tryed to keep forme furnish in a citison of a Foren Countrey, a sample of my spelling But you have cornerd me and her it is. Hoping we may soon have things adjusted to your satisfaction I reman as ever

"J. M. Robbins.

"Fort Worth, Texas, July 3rd, 1899."

American Lenses in European Observatories.

A letter from Mr. John A. Brashear recently received contains the following important information:

"It may interest you to know that we are just sending to the astronomical observatory of the University of Heidelberg the second big camera lens that we have made for them. Each system is made after what is called the 'doublet form;' that is, four lenses in each combination, the lenses being 16 inches in diameter and of 80 inches focal length. They are to be used for the photographic discovery of asteroids. This particular lens is next to the largest ever made for astronomical photography, and has been one of the most difficult tasks we have yet undertaken, the demands for a large field being such that it was difficult to obtain, but we have had great success, and hope to see good results come from our labors."

Obituary.

Theodore Alteneder, head and founder of Theodore Alteneder & Sons, Philadelphia, makers of mathematical instruments, died December 27, seventy-seven years old. Mr. Alteneder was a native of Bavaria, and came to this country in 1847. He began the manufacture of instruments in Philadelphia, and his inventions and improvements have made his name familiar to the engineering profession. He was a member of the Franklin Institute.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 8.)

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

Parallel attachments for drawing board or table, $1.50. F. G. Hobart, Beloit, Wis.; cir'lrs.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Wanted—Copy of the "American Machinist," good condition, for January 12, 1899. Address, with price, W. H. P., Amer. Mach.

For Sale—Two geared Ferracute presses, 62 in. between uprights; little used, and in good condition. Address W. H. Mullins, Salem, Ohio.

Engineers, firemen, machinists and electricians, send 10 cents for 24-page pamphlet containing list of questions asked by Examining Board of Engineers. Geo. A. Zeller, bookseller, St. Louis, Mo. Mention Amer. Mach.

For Sale—Niles half-universal radial; drills to center of 90 in. For exchange—28 in. by 22 ft. Fifield lathe for 32 in. or 36 in. by 12 ft. or 14 ft. lathe. Wanted—42 in. or 48 in. by 12 ft. or 14 ft. planer. Address Middletown Machine Co., Middletown, Ohio.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for

the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Wanted—Position, by experienced tracer and detailer. Box 95, AMERICAN MACHINIST.

Sober, reliable, experienced pattern maker, not afraid of work, desires a change. Box 102, AMERICAN MACHINIST.

Wanted—Position by draftsman; 10 years' experience as machinist and draftsman. Box 94. AMERICAN MACHINIST.

Mechanical draftsman of extensive experience wants position as assistant draftsman. Box 101, AMERICAN MACHINIST.

Wanted—Foremanship of iron foundry, by foreman, experienced on engine and general jobbing work. Address Box 83, AM. MACH.

Foreman machinist wishes position, Philadelphia district; first-class ability; satisfaction guaranteed; light or heavy work. Box 99, AMERICAN MACHINIST.

First-class toolmaker and draftsman; up on experimenting for typewriters and similar class of work; able to design jigs and fixtures. Box 108, AMERICAN MACHINIST.

Mechanical engineer, 15 years' experience selling, designing and office management, pump and engine work, technical trained, open to engagement February 1. Box 109, AMERICAN MACHINIST.

Position as foreman in machine department; 15 years' experience on all kinds of screw machine work, the last 7 as foreman in machine screw and bicycle plants. Address Box 100, AMERICAN MACHINIST.

A thorough, practical machinist, 36 years old, 6 years' experience as foreman, used to special and general machine shop work, accustomed to handle men, wants position as foreman. Address Box 107, AMER. MACH.

Wanted—Position on business side of technical establishment, by a technical graduate with 4 years' experience designing hydraulic and special machinery, also some business experience. Box 103, AMERICAN MACHINIST.

Tool maker and machinist with ability, had charge 25 toolmakers on fine automatic machinery and interchangable tools, up-to-date methods, getting work out quickly, desires position. Box 104, AMERICAN MACHINIST.

All-round machinist and toolmaker desires position as general foreman or superintendent; has experience as such; familiar with electrical machinery; references from present employers. Box 98, AMERICAN MACHINIST.

Superintendent of a concern manufacturing a fine mechanism in connection with a clock movement, desires to change; experienced gun, sewing machine, watch and typewriter factories; American, 38 years. Box 96, AMERICAN MACHINIST.

A Massachusetts man, 36, wants position as foreman of large shop or tool-room; 15 years' experience machine tools, watch factory, gun, sewing machines, typewriting and setting machines, tools, jigs and fixtures, compound punches and dies; first-class references. Box 97, AMERICAN MACHINIST.

(*Continued on page* 44.)

S'pose You Could

Save from 50 to 75 per cent. of the money you pay for oil, wouldn't it be worth while?
A 30 days' trial of the
CROSS OIL FILTER
will prove that this can be done, and the trial is free.
Send for Catalog 16.
THE BURT MFG. CO.,
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AKRON, OHIO, U.S.A.
Largest manufacturers of Oil Filters in the world.

CLEVELAND GEAR WORKS,
W. R. SAWYER, Lessee.
86 SENECA STREET, CLEVELAND, O.

GEARS of all descriptions.

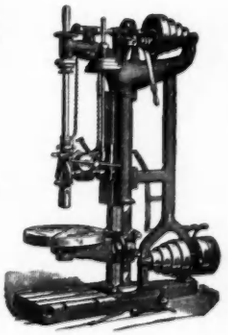
MECHANICAL ENGINEERS AND DRAFTSMEN
WANTED.
Capable and Experienced Men should become acquainted with us.
Our business is to secure good positions for first-class mechanical, civil and electrical engineers and draftsmen.
WRITE US, stating your experience briefly, and we will send you the necessary papers to be filled out in full.
The Engineering Agency,
1605 Monadnock Block, CHICAGO, U.S.A.

Evans Friction-Cone Pulleys
for varying speed. 6000 sets in operation transmitting from 1 to 40 H. P.

Send for Catalogue.
G. F. EVANS, - 85 Water St., Boston, Mass.
C. W. Burton, Griffiths & Co., London Agents.

NEW AND SECOND-HAND MACHINERY.
31 x 16 Bradford Lathe, new.
25 x 16 Bradford Lathe, new.
25 x 14 Bradford Lathe, new.
25 x 12 Bradford Lathe, new.
21 x 10 Bradford Lathe, new.
18 x 8 Springfield Lathe, compound rest, new.
14 x 6 Springfield Lathe, compound rest, new.
14 x 6 Springfield Lathe, comp. rest. & taper.
14 x 6 Le Blond, compound rest.
14 x 6 Le Blond, compound rest & taper.
14 x 8 Sebastian, plain, second-hand.
14 x 6 Sebastian, plain, new.
14 x 6 Sebastian, compound, new.
12 x 5 Sebastian, plain, second-hand.
26 in. Cin. triple geared Shaper, new.
24 in. Cin. back geared Shaper, new.
20 in. Cin. back geared shaper, new.
16 in. Cin. single geared Shaper, new.
72 in. Wm. Bement Radial Drill, second-hand.
The above is only a portion of our stock of tools.
S. M. YORK CO., Cleveland, Ohio.

The Latest 32-in. Upright Drill Press
has the best **Quick Return** yet devised (patented).
Improved Sliding Head, easily adjusted.
Is made throughout of the best material obtainable.
We build this drill in
25 in., 28 in., 32 in., 36 in. and 40 in. All sizes have Automatic Stop.
Write for our illustrated catalog.
The Hamilton Machine Tool Co.,
Hamilton, Ohio, U. S. A.



Personal.

Ambrose Swasey, of Warner & Swasey, Cleveland, intends to sail for Europe this month, and will be abroad several months.

A fact which may be of considerable importance to machine designers in some cases is that the New Process Raw Hide Company, of Syracuse, N. Y., have adapted their process to the making of bevel raw-hide pinions as well as spur pinions, and experience with these is showing that they possess all the advantages of raw-hide spur pinions.

Technical Publications.

"The Mechanical World Pocket Diary and Year Book for 1900." 244 4x6-inch pages, with about 100 illustrations. The Mechanical World, Manchester, England. Price sixpence.

We are glad to note the reappearance of this well-known pocket book, which has now reached its thirteenth year of publication. The present edition contains some new matter on electrical power and transmission. Its usefulness and value are out of all proportion to its price.

"Proceedings of the Society for the Promotion of Engineering Education." Vol. VII. 188 5¾ x 8¼-inch pages. Published by the Society.

The papers which make up this volume have been duly noted in our account of the meeting at Columbus, Ohio, last August, at which they were read. One of them—"An Apprentice System in College Shops," by Prof. O. P. Hood—was given in full in our issue of August 24 last. Another of more than usual interest, is on "The Correspondence School in Technical Education," by Prof. Edgar Marburg. This paper is the result of considerable investigation of such schools, and while the author deplores their methods of advertising, insists that they promise more than they can possibly perform, and claims that some of them are simply charlatan in character, he frankly owns that some of them are doing valuable work. Other papers relate to the conduct of engineering education and are of interest chiefly to professional educators. The society now numbers 251 members, some of whom are found in Canada, England, France, Switzerland and Germany.

New Catalogs.

Perry Ransom, Oshkosh, Wis., sends us catalog of grinding and polishing machinery. The machines illustrated are of various styles and sizes. Catalog is standard size, 6x9 inches.

Millers Falls Company, Millers Falls, Mass., have sent us copy of catalog No. 26, in which is illustrated and described a large variety of tools and light machinery, including braces, saws, vises, breast drills, etc. The catalog is standard size, 6x9 inches.

Elmer G. Willyoung, 82-84 Fulton street,

N. Y., has sent us a copy of Catalog "W," in which is illustrated and described a large variety of electrical and scientific instruments. The details regarding the various instruments are very complete, and to those who have to do with such matters the catalog ought to be of interest. It is standard size, 6x9 inches.

Manufacturers.

Park Bros. & Co., of Pittsburgh, Pa., have purchased land at West Elizabeth, to which place it is the intention to remove their plant.

The borough of Paulsboro, N. J., is at present seriously contemplating the construction of new water works and an electric lighting plant.

The plant of the E. S. Stiles Press Company, of Watertown, N. Y., including patterns, patents, machine tools, etc., has been purchased and will be operated by G. A. Crosby & Co., Chicago.

The Jones Scale Works, Binghamton, N. Y., were gutted by fire recently. The work of rebuilding will be rushed through, as the firm is behind in its orders. The loss is estimated at $25,000, covered by insurance.

Kent Brothers have started work on the mill building to be erected at Burmont, Pa., Delaware County, which is to be face brick and measure 65x210 feet. An engine room, boiler and dynamo room, storage rooms, office equipment, etc., will be provided.

Ground has been broken on Sanford avenue, Bridgeport, Conn., for an addition to the factory of Hon. Thomas P. Taylor, for which Marsh Bros. have the entire contract. It will be 44x75 feet, two stories high, of brick, covered with Bullard's gravel roofing.

Threatened with the loss of the Cambria Steel Company's big industry, Johnstown's (Pa.) despondency has been turned into rejoicing by the announcement that the plant will remain, and that, in addition, the company will erect additional works in that city.

The firm of Brioschi, Finzi & Co., of Milan, Italy, an account of whose works we gave in our issue of August 17, 1899, will increase its capital, and $120,000 is to be spent on the plant. They would be pleased to receive catalogs from American machine tool builders.

Alfred Herbert, Limited, Coventry, England, inform us that they have just moved into new offices, and would like to bring their collection of American catalogs up to date, and would be happy to receive for reference copies of American machine tool catalogs of all descriptions.

Roydhouse, Arey & Co. have submitted plans for work on the machine shop of the Baldwin Locomotive Works, Philadelphia, Pa. It consists in taking off one story from the present building, 207 by 77 feet, and putting on four additional stories, making the building six stories in hight.

A large steel plant is to be constructed at Pottstown, Pa., by a private company, and $20,000 has been raised by the city authorities of the place, which will be used in its completion. The most improved machinery, etc., is to be provided. There is also a movement on hand to erect later a cigar factory building.

Contractors William Steele & Son have their plans and specifications for a manufacturing plant, which the Moss Rose Manufacturing Company propose to have built at the northwest corner of Hancock street and Allegheny avenue, Philadelphia, Pa. The buildings will be constructed of stone, brick, terra cotta, hemlock and iron. The mill will be four stories high, 50.4 by 201 feet.

Situations Wanted—Cont'd.

Toolmaker and machinist of ability and long experience will shortly be open for engagement; expert on labor-saving tools and up-to-the-minute methods of doing things; good draftsman; accustomed to handling men on first-class work so as to get quick results at small cost. Box 84, AMER. MACH.

Help Wanted.

Two machinists and toolmakers; new tools and machines. Cochrane Bly Machine Works, Rochester, N. Y.

Pattern makers wanted at once by the Fishkill Landing Machine Co. Apply Fishkill-on-the-Hudson, N. Y.

Draftsman wanted on mill machinery and machine tools. Apply to Bethlehem Steel Co., South Bethlehem, Pa.

Wanted—A man to take the lead in foundry on cylinder work, in a locomotive works. Address Box 66, AMERICAN MACHINIST.

Superintendent to take charge of engine works employing 100 to 200 men; state age, nationality and previous experience. Box 80, AMERICAN MACHINIST.

Wanted—Experienced foundry foreman for Corliss and other heavy work; permanent employment and good salary assured. Address Box 81, AMERICAN MACHINIST.

Draftsmen and tracers wanted, in New York City; permanent positions to the right men. Address, giving experience and references, Box 91, AMERICAN MACHINIST.

Wanted—Experienced draftsman, to work on cotton machinery; good position for an A1 man; state experience, references and salary expected. Address Box 64, AMER. MACHINIST.

Wanted—A good general machinist; steady work; wages $2.50 per day; married man with family preferred. Write, stating qualifications to Manufacturer, care AMER. MACH.

Wanted—Six mechanical draftsmen, for rolling mill and blast furnace work; a good opportunity for rapid, reliable men; state experience and salary. Box 105, AMER. MACH.

All-around leading machinist wanted for small shop; must make own tools; experienced in electric switch work desirable; give references, age and full particulars. Box 106, AMERICAN MACHINIST.

Machinists—A few machinists can secure positions in a good shop about one hour's ride from New York city; on lathe, vise and all-around work. Write, stating experience and qualifications to Box 89, AMER. MACH.

Wanted—By a manufacturing company, 50 miles from Chicago, six good machinists to work on moderately light machinery; steady employment and the best wages will be given to the right men. Address promptly Western Cane Seating Co., Michigan City, Ind.

Wanted—A competent machinist, with executive ability, to take charge of the tool department of a large manufacturing establishment; the work consists of repairs and new tools; good pay to the right man. Address, stating experience, Box 73, AM. MACH.

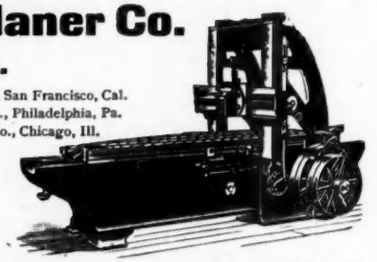
Wanted—A machinist accustomed to running a large-size Gisholt turret lathe; must be an energetic man, of good habits and character and capable of handling the machine to the best advantage; write, stating where last employed, wages required, age, etc. Address Farrel Fdy & Mach. Co., Ansonia, Conn.

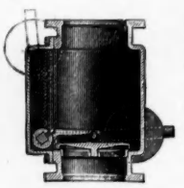
Woodward & Powell Planer Co.

WORCESTER, MASS.

U. Baird Machinery Co., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy. Co., St. Louis, Mo.
Parke & Lacy Co., San Francisco, Cal.
The Fairbanks Co., Philadelphia, Pa.
Pratt & Whitney Co., Chicago, Ill.

De Fries & Co., Dusseldorf and Berlin, Germany.
A. Janssens, Paris, France.
A. Janssens, Bruxelles, Belgium.
Burton, Griffiths & Co., London, Eng.
Sonessons & Co., Malmo, Sweden.





Excelsior Straight-Way Back Pressure Valve.

This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

Jenkins Brothers, New York, Boston, Philadelphia, Chicago.

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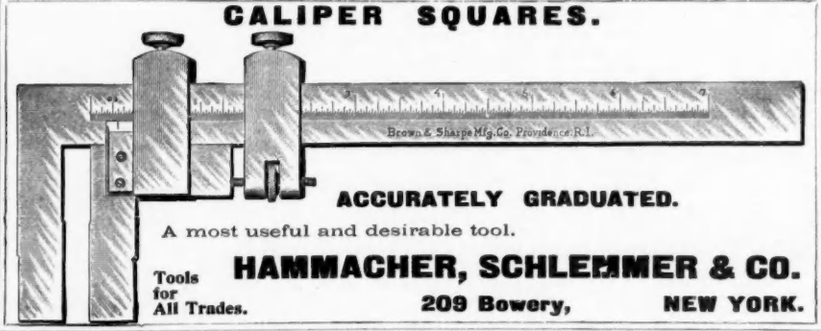

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